Chemical & Engineering NEWS

FINAL PROGRAM
ACS spring meeting, Las Vegas
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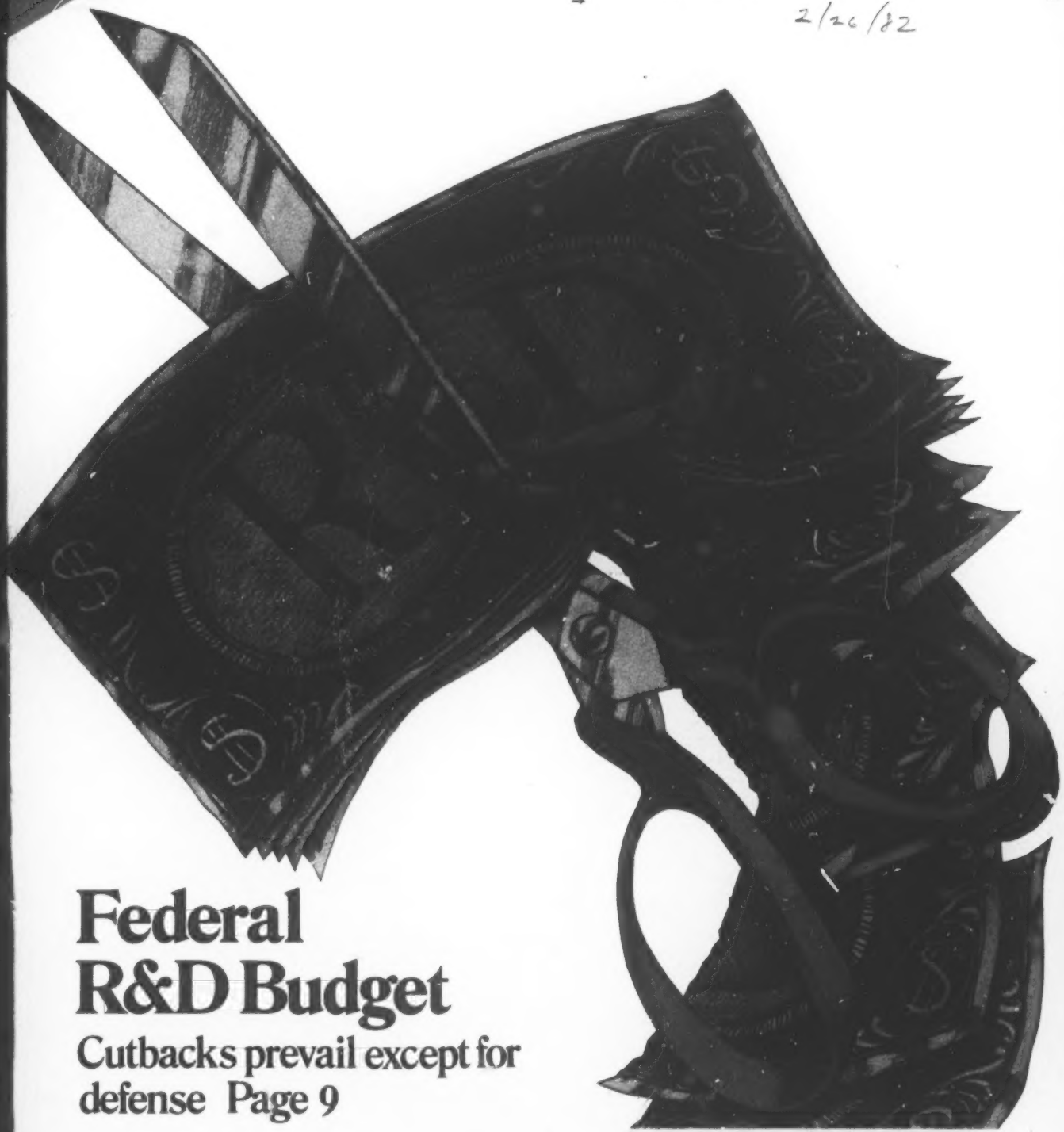

# Federal R&D Budget

## Cutbacks prevail except for defense Page 9

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# Chemical & Engineering NEWS

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## News of the Week

- ***New series of engineering plastics*** *based on polyetherimide resin chemistry has been introduced by General Electric.* ***Page 6***
- ***Superfund cleanup of hazardous waste sites*** *will be managed by the Army Corps of Engineers under agreement with EPA.* ***Page 6***
- ***DNA committee has retreated*** *from its earlier position, now recommends adopting much of the substance of NIH safety guidelines for doing DNA research.* ***Page 7***
- ***Fertilizer is in for a tough year*** *with commodity prices depressed and farmers' real income down sharply.* ***Page 7***
- ***Production of stable isotopes*** *of many elements needed for research, medicine, and industry is falling short.* ***Page 8***
- ***One of the last barriers to renewed U.S. chemical arms output*** *has been broken down with a letter to the House from Reagan certifying need for such arms.* ***Page 8***

## News Focus

- ***Federal funding for R&D*** *in fiscal 1983 would be up about 10% overall in Administration's budget request, but most of that increase would go to Defense Department.* ***Page 9***

## Business

- ***Unexpected new recession*** *hit the U.S. chemical industry in the fourth quarter, dealing earnings a blow that likely will be felt until mid-year 1982.* ***Page 16***

## Science

- ***Triggering of immune system*** *by clustering of cell surface receptors proposed by Johns Hopkins University researchers.* ***Page 27***

## Perkin Medal

- ***Herbert C. Brown*** *awarded Perkin Medal in recognition of outstanding contributions in applied chemistry.* ***Page 29***

## Education

- ***Proportion of recent Ph.D.s*** *on science faculties in Ph.D.-granting departments continues to decline.* ***Page 32***

## Technology

- ***Gasification tests using moist peat*** *have been completed successfully in IGT's Chicago pilot plant.* ***Page 33***
- ***Gene has been cloned*** *for rennin, an enzyme used in cheesemaking.* ***Page 34***

## ACS News

- ***Advisory board members*** *for society's publications named.* ***Page 35***

## Final Program

- ***Program for ACS National Meeting*** *in Las Vegas includes technical sessions, chemical exposition, social events.* ***Page 38***

up, and help maintain consistency with EPA's program requirements.

Funding for the corps' part of the program will come from the $1.6 billion superfund, which is budgeted for $190 million in fiscal 1982 and $230 million for 1983. In addition to supporting EPA and the corps in this work, the money also will be used to fund the contractors for the remedial cleanup. EPA also will manage liaison with the states and other groups regarding cleanup and handle all preliminary measures at hazardous sites, such as early investigations and feasibility studies.

In addition, the corps will not be required to manage any remedial plan proposed by EPA that the corps does not think feasible. The agreement between the two agencies is for two years. The superfund law, passed in 1980, is to run through 1985, but Gorsuch says that cleanup action at the hazardous sites is expected to last beyond that time. □

## DNA group backtracks, wants some guidelines

The Recombinant DNA Advisory Committee (RAC) now recommends adopting proposals that simplify but do not eliminate much of the substance of the National Institutes of Health safety guidelines for doing recombinant DNA research.

In so doing, the committee backtracked from the position it held last fall when it recommended that the guidelines become a code of voluntary practices, that the limited sanctions against researchers who fail to comply be dropped, and that all requirements for prior approval of experimental protocols be eliminated (C&EN, Sept. 21, 1981, page 6). RAC's retreat led to adopting a minority set of proposals, put together by former RAC member and NIH senior investigator Susan K. Gottesman. The rejected set of proposals had been presented by RAC member David Baltimore, a biologist at Massachusetts Institute of Technology and also the head of the new MIT-affiliated Whitehead Institute for Biomedical Research.

Both sets of proposals were published in the *Federal Register* last December (C&EN, Dec. 21, 1981, page 25). Thus, the newly approved Gottesman proposal can take effect whenever approved by either Richard M. Krause of NIH, who currently holds that authority, or a new NIH director, still to be appointed.

The Gottesman proposals leave certain features of the current NIH guidelines intact. During the February meeting of RAC, a change of heart surfaced as to the value of preserving some of those provisions and slowing down an earlier move to declare gene-splicing research finally safe enough to be left to self-governance.

The public response to the two sets of proposals, as represented in dozens of letters sent to NIH, has been mixed. Though many letters espouse doing away with much in the guidelines and adopting Baltimore's proposals, many of the letters recommend a more cautious, middle-of-the-road stance.

This same mix is reflected within RAC itself and helped to lead to the backtracking. Baltimore implored the committee to a bolder move: "RAC's function is to lead the world, not follow," he says. "We must make the assessment of risk and tell the city of Cambridge and of Waltham and tell California that it's our opinion that regulations beyond our recommendations are not necessary. That this is national policy."

This suggestion, though debated, was not followed by RAC, which elected to err toward the side of caution instead.

An important vehicle for ensuring that caution is exercised, for example, is the institutional biosafety committees (ICBs) that Gottesman's proposal leaves intact. There still are questions regarding certain experiments, Gottesman noted during the RAC meeting. "Someone else should be overseeing them. It makes sense to say 'we really mean this.' Let's say that explicitly."

C&EN staff photo

*Gottesman: guidelines not bureaucracy*

Leaving the NIH guidelines in place also might help to prevent the fragmentary, community-by-community introduction of regulations that some observers fear may occur if the federal presence disappears. Besides, Gottesman's proposals are a long way from the cumbersome guidelines of a few years ago. "My proposal does nothing to bring back all the experiments that are now exempted," she points out. "Having mandatory guidelines is not synonymous with bureaucracy. The basic structure is simple enough to last a long time." □

## Farmers' slump hurts fertilizer sales

The 1982 fertilizer year? "It's going to be a tough row to hoe," says Edwin M. Wheeler, president of the Fertilizer Institute. At the institute's annual meeting in Chicago, Wheeler noted that although farmers' costs were up, commodity prices were depressed and farmers' real income was down dramatically. "We do well when our farmers prosper, but we suffer when they suffer," he observes.

For the full fertilizer year (July 1981 through June 1982), Wheeler predicts that U.S. nitrogen consumption will drop 2 to 5%, compared to the preceding year. Phosphate consumption will be down 10 to 15%, he says, and potash consumption will be off 10 to 12%.

Latest institute and government figures for the second half of 1981 give weight to Wheeler's gloomy predictions. U.S. fertilizer consumption, in terms of "domestic disappearance," declined 9% from the record year-earlier period. Fertilizer exports decreased 28%. Inventories of all products increased 32%, despite a 7% production cutback during the period.

Nitrogen products were least affected, with production steady, domestic disappearance off 3%, and inventories up 28%. Exports of all nitrogen products were down, however, and solid urea exports were off a sharp 35%.

Phosphate rock production decreased 7% during the six-month period. At the same time, wet process phosphoric acid production decreased 23%, leaving year-end rock inventories of nearly 20 million tons, 49%

## Fertilizer consumption drops 9%

| Index change, July–December 1981 vs. 1980 | Production | Ending inventory | Domestic disappearance |
|---|---|---|---|
| Nitrogen products | 0% | 28% | −3% |
| Phosphate rock | −7 | 49 | −23 |
| Processed phosphates[a] | −26 | 37 | −27 |
| Potash products | −2 | 112 | −11 |
| Mixtures | −27 | 12 | −28 |
| All products[a] | −7 | 32 | −9 |

a Excludes some product types. **Source:** Fertilizer Institute

higher than a year earlier. For processed phosphates as a group, production declined 26% and consumption dropped 27%, while year-end inventories grew 37%. One bright spot was a 44% increase in phosphoric acid exports during the period. For other phosphates, however, exports decreased from 1980 levels.

U.S. production of potash products decreased 2% during the July-through-December period; potash consumption declined 11%; and year-end inventories more than doubled, to 112% of 1980 levels. Potash exports were down 39% and imports, mostly from Canada, were down 11%.

Domestic disappearance of NPK solid mixtures (the best indicator of fertilizer movement to farms, the institute notes) decreased 28% during the six-month period. Production of solid mixtures decreased 27%, while ending inventories rose 12%. □

## U.S. faces stable isotope shortage

The U.S. is falling short in producing separated stable isotopes of many elements in amounts needed for research, medicine, and industry. Highly enriched stable isotopes themselves are used in studies of the nucleus, as reference standards for dating and atomic weight determinations, and for analytical methods in which such properties as nuclear spin are important. Stable isotopes also are precursors for production of radioactive isotopes by neutron irradiation or charged particle bombardment for radiochemical research, medical diagnosis and treatment, and industrial use.

This shortage problem came under scrutiny at a workshop for suppliers and customers held by the National Research Council's Committee on Chemical Sciences and its Subcommittee on Nuclear and Radiochemistry and supported by the Department of Energy and the National Institutes of Health. NRC plans to issue a report on it in April.

Production shortfalls of concern are occurring at the electromagnetic isotope separating facility at Oak Ridge National Laboratory in Tennessee. ORNL separates isotopes of most stable elements from magnesium to bismuth in banks of modified cyclotrons. Of 225 stable isotopes ORNL can produce, 60 are now out of stock, with waiting times of a few years before they can be replenished. Lagging production rates will result in increased inventory gaps as scientists continue to buy.

One problem is that ORNL operates only two of its four banks of separators for stable isotopes on an annual budget of $2.5 million. Each bank can separate about 0.1 gram atom of one element per 24-hour day, running five days per week. Eugene Newman, head of ORNL's isotopes section, told workshop attendees that he could serve present needs and begin rebuilding inventories, if he could run all four separator banks.

A second problem is the different needs of ORNL's research and industrial customers. Scientists tend to need small amounts of every isotope of all the elements for specific projects. Companies that supply radiopharmaceuticals need large amounts of a few isotopes. Newman estimates that 80% of his unit's activity in the past year went to supply large amounts of isotopes of only four elements. □

## President certifies chemical arms need

President Reagan now has knocked down one of the few remaining barriers to renewed U.S. production of chemical warfare weapons. Last week, in a letter to House Speaker Thomas P. O'Neill Jr. (D.-Mass.), Reagan certified "that the production of lethal binary chemical munitions is essential to the national interest." That letter ends a nearly 13-year moratorium on chemical arms manufacture.

In a supporting document, the Defense Department says that "the overall military balance between the U.S. and the Soviets" does not allow the U.S. to call on its other weapons to deter chemical warfare. According to Pentagon reasoning, a beefed-up chemical retaliatory capability will offer deterrence and an incentive to the Soviets to negotiate a comprehensive and verifiable ban on such weapons.

Current chemical stocks are an ineffective deterrent, the Pentagon claims. Most of the stockpile is stored in bulk containers and the remainder is in ammunition for weapons that are obsolete or soon will be retired. Also no chemical weapon in stock has a long enough range to penetrate "the rear echelons of attacking forces," according to the Pentagon.

To correct these defects, the Pentagon plans to manufacture so-called binary 155 mm artillery shells and Bigeye bombs. In these weapons, two nontoxic chemicals would mix in flight to form lethal nerve gases. In addition to these short-range weapons, the Army also is studying the feasibility of producing longer range delivery systems, including the ground launched cruise missile, and more potent chemical agents.

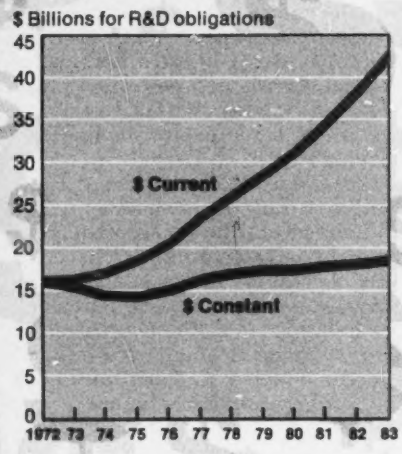
The Pentagon claims that binary weapons offer "considerable safety, security, and logistical advantages" over present unitary weapons. Yet no accident has ever been reported in the manufacture, storage, transportation, or disposal of the unitary weapons. And Harvard University biochemist Matthew Meselson, a chemical arms expert, recently told a scientific meeting that binary arms would be difficult to assemble under tense battlefield conditions.

Because of the issue's sensitivity, the Pentagon says no decision has been made on overseas deployment of these new weapons. Such a decision would be made with "full consultation" of the nations involved.

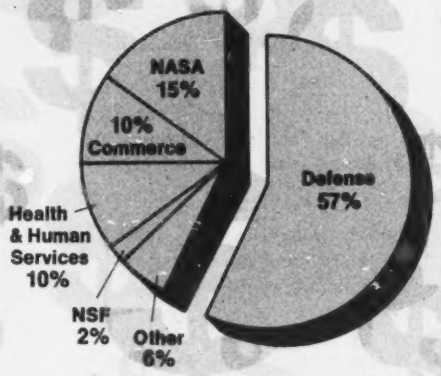
The Administration has requested fiscal 1983 funds totalling $705 million to support its expanded chemical program. More than 70%, or $508 million of that, is to improve all aspects of chemical defense. Nearly 20%, including $30 million for the procurement of binary arms, is slated for the retaliatory program. The U.S. still maintains a no-first-use, retaliation-in-kind strategy, and the Pentagon says it has no plan to match the Soviets in kind or quantity of agent or munition. But it will build an offensive program that can "deny a significant military advantage to any initiator of chemical warfare."

Congress still has the final say in this matter, however. It could block renewed chemical arms production by deleting the requested funds from the budget. □

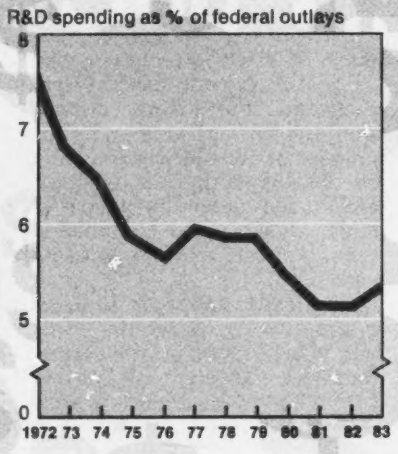
**R&D funds to rise 4% in constant dollars**




**Department of Defense gets well over 50% of R&D budget**




**R&D funding accounts for 5% of federal outlays**




# Federal R&D holds its own in fiscal '83 budget

**Overall research funding would increase about 10% under Administration's budget requests, but more than 90% of that increase is slated for the Department of Defense, and most agencies barely are keeping up with inflation**

Janice R. Long and David J. Hanson
C&EN, Washington

President Reagan officially presented his first complete budget proposal to Congress last Monday. And, despite predictions of doom, research as a whole would not fare too badly. In a budget that would rise only a little more than 4% to $757.6 billion, but with a $91.5 billion deficit, outlays for federal R&D funding would be up just less than 10% to $41.1 billion. Obligations for R&D would be up almost 11% to a little less than $43 billion.

But—and there are some important buts—94% of that $4.2 billion increase in obligations is slated for the Department of Defense, whose R&D budget would account for 57% of the total federal R&D budget in fiscal 1983, 10% more than it did in fiscal 1981. Whether the R&D budgets of many other federal agencies will be up, even, or down in constant-dollar terms depends in large part on how accurate is the Administration's prediction of a mere 6.5% inflation rate in 1983. And, most important, in the proposed 1983 budget R&D funding requests for a few agencies are actually below not only fiscal 1982 but fiscal 1981 funding levels as well.

One bright spot is that basic research would be exempted from the budget scissors. Total obligations would be up 8.8%, or $473 million, to $5.8 billion. Outlays, however, would be up only 4.4%, or $238 million, to $5.5 billion. The largest increases for basic research are slated for the National Aeronautics & Space Administration, up 18%, and for DOD, up 16%. Support for basic research by the Environmental Protection Agency and the Department of Interior would be down 33% and 7%, respectively. Those are the only agencies slated for a decrease in basic research.

The Office of Management & Budget, in the special analysis of the federal R&D budget that it prepares, points out that "about one half of the total federal obligations for basic research are made to support researchers in universities and colleges." But this year OMB has not prepared a separate breakout, by agency, of federal R&D funds slated for colleges and universities as it has in the past. The reason, as one OMB official puts it, is that "historically the breakout has not been too accurate" and there have been, and are, questions about the credibility of the data.

However, OMB, as usual, has broken out funding for R&D facilities and in that category the news is bad. Obligations would be down 17%, or $265 million, to $1.3 billion, and outlays would be down almost 30%, or $503 million, to $1.2 billion.

A breakdown of the federal R&D budget by agency clearly shows that with its huge 21.3% increase in research, development, testing, and evaluation funding for fiscal 1983, the Department of Defense overshadows all the rest of federal R&D spending combined. Most of the

$24.3 billion requested, however, would be spent on development and testing of huge weapons systems. Only $781 million, up from $673 million in the revised 1982 budget, would be spent on basic research.

Most of the funding for development of existing technology would go to strategic and tactical weapons programs. For instance, increases would go toward accelerated development of alternatives for MX missile basing, either in deep underground silos or continuous-patrol aircraft; an advanced technology B1-type bomber; and an antisatellite system.

Tactically, under the budget proposal the Army would continue major efforts to improve the performance and capabilities of the M-1 tank, chemical weapons defense equipment, and chemical weapons. The Air Force would move on development of improved night and foul weather navigation systems and the AMRAAM advanced medium range air-to-air missile. The Navy would develop a lightweight antisubmarine torpedo, a new destroyer, and a vertical launch system for missiles.

For its technology base, DOD continues to develop promising new technologies. Current work on high-speed integrated circuits and guided missiles will continue. Increased emphasis would be placed on improved information processing, better materials, and improving sensing devices. Other programs listed by DOD for fiscal 1983 include a lot of electronic technology, such as devices that continue to work after some components have failed, electronics that are resistant to radiation, advanced computer languages, and high-power lasers.

The defense activities of the Department of Commerce also are slated for a sizable increase of 15%, or $657 million, to $5.1 billion in fiscal 1983. (That's right—Commerce. For the purpose of preparing this budget OMB decided that the Department of Energy no longer existed, even though legislation for its dismantlement has not been sent to, let alone approved by, Congress. But whether DOE stays DOE or its programs go to Commerce, the numbers are the same.)

The large increase for defense activities comes hard on the heels of a 27% rise in fiscal 1982. Weapons activities are slated for a 16% increase to $3.2 billion, with $1.1 billion, an increase of 15%, earmarked for R&D and testing. Funding for materials production would be up 14% to $1.0 billion, defense waste management up 6% to about $408 million, naval reactors development up 17% to about $392 million, verification and control technology up 7% to $52.5 million, nuclear materials security and safeguards up 9% to $46.7 million, and security investigations up 26% to $26 million.

With two exceptions, funding for the other research programs Commerce may or may not inherit from DOE can best be described as disaster areas. One of the exceptions is general science and research, funding for which would be up 11% to $601 million. Within that category, funding for nuclear physics would be up 16% to almost $133 million and high-energy physics would be up 11% to $426 million. However, funding for life sciences research and nuclear medicine applications would be down 23% to $38.6 million.

The other exception is what is called supporting research and technical analysis, funding for which would be up 5% to about $292 million. Within that category funding for basic energy sciences would be up overall 16% to nearly $283 million, with funding for chemical sciences up 11% to $75.9 million, and that for materials research up about 14% to $120 million.

Those increases reinforce the Administration's ongoing determination to redirect energy R&D programs to emphasize long-term research. The cuts in the other energy research areas emphasize the Administration's determination to rely on the private sector for technology development.

For example, fossil energy R&D funding would be down 83% to $107 million, primarily because the government is getting out of the business of demonstrating energy technologies. Much the same reasoning lies behind the 65% cut in the solar energy budget to about $159 million, and the 76% cut to $65.2 million in the conservation R&D budget.

The government plans to concentrate its fossil energy research efforts in areas such as instrumentation, environmental effects, coal chemistry, and catalysis. The solar program would focus on basic generic research in such areas as materials science and photobiology. In addition, $27 million would be provided for photovoltaic research but all remaining federally funded research on electric energy systems and energy storage systems would be phased out.

Even the nuclear programs, which the Administration specifically highlighted in a section of the budget entitled "Increasing Investment in Research and Development," would be cut back. The nuclear fission program would be cut 28% to $852 million and magnetic fusion 8% to about $433 million. The breeder reactor program would be cut 16%, even while the funding for the Clinch River breeder reactor would more than double to $254 million. The light water reactor program would be slashed 73% to $32 million, with part of the funding allocated for research at the damaged Three Mile Island nuclear plant.

There is one new initiative in the nuclear area. The Administration is requesting almost $180 million for R&D and site investigations for a terminal isolation nuclear waste repository. It also plans to ask Congress to enact legislation imposing a kilowatt-per-hour fee on nuclear electricity generators, which is expected to raise $300 million, to operate a permanent disposal site.

The Commerce Department's old-line research programs didn't fare much better than its new energy programs in the budget request. For example, funding for the National

### Glossary of budget terms

**Deferral.** Any executive branch action or inaction that delays the availability of budget authority for obligations. Deferrals may not extend beyond the end of the fiscal year and may be overturned at any time by either branch of Congress.

**Fiscal year.** Year running from Oct. 1 to Sept. 30. The fiscal year is designated by the calendar year in which it ends.

**Outlays.** Payments for obligations incurred under budget authority, generally made by issuance of checks by Treasury. Outlays during any fiscal year may be payments of obligations incurred in prior fiscal years or in the same fiscal year.

**Rescission.** Enacted legislation canceling budget authority previously granted by Congress. Rescissions proposed by the President must be approved by Congress within 45 days to become effective.

## The total federal R&D package

### Agency by agency R&D funding breaks down like this

| $ Millions | Obligations | | | Outlays | | |
|---|---|---|---|---|---|---|
| | 1983[a] | 1982[a] | 1981[b] | 1983[a] | 1982[a] | 1981[b] |
| Defense | $24,489 | $20,553 | $16,494 | $22,673 | $18,784 | $15,720 |
| NASA | 6,513 | 5,841 | 5,407 | 6,460 | 5,696 | 5,279 |
| Commerce | 4,157 | 4,793 | 5,276 | 4,352 | 5,240 | 5,466 |
| HHS | 4,122 | 3,972 | 3,973 | 4,039 | 3,935 | 3,991 |
| NSF | 1,033 | 961 | 964 | 908 | 1,018 | 892 |
| USDA | 838 | 807 | 773 | 824 | 805 | 742 |
| Interior | 371 | 397 | 424 | 380 | 402 | 438 |
| Transportation | 366 | 329 | 420 | 316 | 321 | 418 |
| EPA | 230 | 317 | 326 | 274 | 335 | 344 |
| Nuclear Regulatory Commission | 220 | 223 | 227 | 206 | 209 | 211 |
| Agency for International Development | 196 | 160 | 156 | 159 | 157 | 151 |
| Veterans Administration | 145 | 137 | 147 | 140 | 130 | 138 |
| Education | 76 | 74 | 91 | 112 | 94 | 96 |
| Other | 272 | 279 | 354 | 280 | 298 | 366 |
| TOTAL | $42,998 | $38,843 | $35,032 | $41,123 | $37,424 | $34,252 |

a Estimates. b Actual. Source: Office of Management & Budget

### Funds for basic research would rise 9% to $5.8 billion

| $ Millions | Obligations | | | Outlays | | |
|---|---|---|---|---|---|---|
| | 1983[a] | 1982[a] | 1981[b] | 1983[a] | 1982[a] | 1981[b] |
| HHS | $2069 | $2000 | $1955 | $2034 | $1978 | $1944 |
| NSF | 984 | 912 | 898 | 881 | 972 | 830 |
| Defense | 781 | 673 | 603 | 712 | 616 | 554 |
| Commerce | 762 | 665 | 608 | 759 | 670 | 614 |
| NASA | 682 | 580 | 532 | 661 | 575 | 538 |
| USDA | 359 | 332 | 314 | 354 | 327 | 302 |
| Interior | 68 | 73 | 80 | 69 | 73 | 79 |
| Smithsonian | 51 | 45 | 44 | 51 | 44 | 41 |
| Veterans Administration | 14 | 13 | 15 | 14 | 13 | 15 |
| Education | 14 | 14 | 17 | 22 | 18 | 18 |
| EPA | 10 | 15 | 10 | 10 | 12 | 12 |
| Other | 28 | 27 | 32 | 28 | 29 | 29 |
| TOTAL | $5822 | $5349 | $5108 | $5575 | $5337 | $4078 |

a Estimates. b Actual. Source: Office of Management & Budget

### Federal funds for R&D facilities would fall 17%

| $ Millions | Obligations | | | Outlays | | |
|---|---|---|---|---|---|---|
| | 1983[a] | 1982[a] | 1981[b] | 1983[a] | 1982[a] | 1981[b] |
| Commerce | $ 681 | $ 964 | $ 982 | $ 644 | $1191 | $1112 |
| Defense | 366 | 285 | 278 | 320 | 248 | 238 |
| NASA | 116 | 143 | 114 | 122 | 135 | 147 |
| USDA | 30 | 35 | 21 | 34 | 39 | 39 |
| HHS | 20 | 62 | 25 | 38 | 35 | 43 |
| NSF | 16 | 10 | 13 | 15 | 10 | 13 |
| Other | 33 | 28 | 47 | 25 | 43 | 35 |
| TOTAL | $1262 | $1527 | $1480 | $1198 | $1701 | $1627 |

a Estimates. b Actual. Source: Office of Management & Budget

Bureau of Standards would be cut 17% to $96.1 million, 5% less than was budgeted in fiscal 1981. Most of the cut is accounted for by the transfer of the governmentwide computer standards program to the General Services Administration. However, funding for central technical support would be down 23% to $17.4 million. Measurement research and standards would be cut 8% to $48.8 million. Funding for engineering measurements and standards, on the other hand, would be up slightly, 6%, to $29.9 million.

The National Oceanic & Atmospheric Administration's budget also would be down more than 8% to about $759 million. Its research budget is expected to fall about 5% to $152 million. Among other things, NOAA is terminating its aquaculture, underseas and ocean dumping research programs; reducing its research on climate and global atmosphere; but increasing its acid precipitation research program.

The National Aeronautics & Space Administration once again has the largest civilian commitment to R&D —$5.3 billion of the agency's $6.6 billion budget is slated for R&D, a 12.5% increase over the revised fiscal 1982 figures. NASA Administrator James M. Beggs believes this is a good increase during a time of tight budgets and readily admits that the budget was prepared based on the priorities of reviving the U.S. economy and strengthening national security.

It is hard to get an exact handle on NASA's budget because of the shifting status of its many ongoing programs. These are funded at different rates for different years, depending on their stage of completion and/or their importance. In general, in fiscal 1983 the space shuttle would get the largest share of the funding, while other projects would get the scraps.

Most of the R&D funds would go for space transportation; and that would be about evenly divided between space shuttle production and system improvements on one side and actual space shuttle operations on the other. The first operational flight of the shuttle is expected early in fiscal 1983, and the increased budget for this will make the shuttle "the workhorse of our civil and military efforts in space through the 1980s," Beggs says.

Space science R&D funding at NASA would rise 16.7% above the revised 1982 figure to $682 million in 1983. This area includes physics

## How the agencies fare

### NSF budget up 8% to over $1 billion . . .

| $ Millions | 1983[a] | 1982[a] | 1981[b] |
|---|---|---|---|
| Mathematical and physical sciences | $ 298.7 | $272.9 | $ 256.5 |
| Astronomical, atmospheric, earth, and ocean sciences | 259.7 | 240.0 | 236.3 |
| Biological, behavioral, and social sciences | 186.7 | 176.0 | 185.6 |
| Engineering | 99.7 | 92.0 | 86.3 |
| Antarctic program | 86.4 | 66.0 | 67.4 |
| Program development and management | 63.1 | 63.5 | 59.2 |
| Scientific, technological, and international affairs | 44.0 | 40.3 | 53.7 |
| Science and engineering education | 15.0 | 20.9 | 70.7 |
| Minority institutions science improvement program | 3.3 | 4.8 | 4.9 |
| Special foreign currency program | 2.2 | 4.6 | 4.0 |
| TOTAL | $1058.8 | $981.0 | $1024.6 |

a Estimates. b Actual. Note: Obligations. Source: National Science Foundation

### . . . with funding for chemistry up 9%

| $ Millions | 1983[a] | 1982[a] | 1981[b] | % change 1982–83 |
|---|---|---|---|---|
| Physics | $ 88.5 | $ 75.3 | $ 72.1 | 17.5% |
| Physiology, cellular, and molecular biology | 85.2 | 79.4 | 78.2 | 7.3 |
| Ocean sciences | 81.0 | 75.8 | 75.0 | 6.9 |
| Materials research | 80.9 | 80.0 | 76.2 | 1.1 |
| Atmospheric sciences | 74.8 | 70.0 | 69.3 | 6.9 |
| Chemistry | 66.1 | 60.7 | 57.6 | 8.9 |
| Astronomical sciences | 63.2 | 59.1 | 58.4 | 6.9 |
| Environmental biology | 45.0 | 42.0 | 41.0 | 7.1 |
| Earth sciences | 34.4 | 29.2 | 27.9 | 17.8 |
| Mathematical sciences | 33.9 | 31.2 | 28.3 | 8.7 |
| Computer research | 29.3 | 25.7 | 22.3 | 14.0 |
| Chemical and process engineering | 22.2 | 20.1 | 18.5 | 10.4 |
| Behavioral and neural sciences | 21.8 | 20.5 | 21.0 | 6.3 |
| Social and economic sciences | 17.8 | 17.6 | 25.1 | 1.1 |
| TOTAL | $744.1 | $686.6 | $670.9 | 8.4% |

a Estimates. b Actual. Note: Obligations. Source: National Science Foundation

### Commerce's research budget down 26%

| $ Millions | 1983[a] | 1982[a] | 1981[b] |
|---|---|---|---|
| Energy Research & Technology Administration | $3759.6 | $5104.7 | $5152.6 |
| Defense R&D and testing | 1075.0 | 934.3 | 793.1 |
| Nuclear fission | 852.1 | 1196.4 | 1127.2 |
| General science and research | 601.0 | 536.0 | 503.4 |
| Magnetic fusion | 432.5 | 469.5 | 416.2 |
| Supporting research | 292.1 | 277.4 | 272.3 |
| Conservation, solar and other renewables | 231.2 | 858.5 | 983.5 |
| Environment | 169.0 | 219.5 | 236.2 |
| Fossil energy | 106.9 | 613.1 | 818.7 |
| NOAA | 182.0 | 159.0 | 201.0 |
| NBS | 96.1 | 116.5 | 101.0 |
| Other | 12.0 | 24.0 | 44.0 |
| TOTAL | $4018.9 | $5404.2 | $5488.6 |

a Estimates. b Actual. Note: Obligations. Sources: Office of Management & Budget, Department of Energy

### NASA gets 11% rise in total R&D funds

| $ Millions | 1983[a] | 1982[a] | 1981[b] |
|---|---|---|---|
| Conduct of R&D | $5334.0 | $4736.0 | $4334.3 |
| Space shuttle | 1718.0 | 2163.0 | 1995.0 |
| Space flight operations | 1707.0 | 895.9 | 679.2 |
| Space tracking & data systems | 508.9 | 402.1 | 339.9 |
| Physics & astronomy | 471.7 | 323.5 | 323.7 |
| Space applications | 316.3 | 325.8 | 331.5 |
| Aeronautical research & technology | 232.0 | 233.0 | 271.4 |
| Planetary exploration | 154.6 | 205.0 | 175.6 |
| Space research & technology | 123.0 | 111.0 | 110.7 |
| Life sciences | 55.7 | 39.5 | 42.2 |
| Expendable launch vehicles | 42.8 | 31.2 | 54.4 |
| Technology utilization | 4.0 | 8.0 | 8.8 |
| Energy technology | — | — | 1.9 |
| Research and program management | 1179.9 | 1144.7 | 1071.1 |
| Construction of facilities | 100.0 | 98.7 | 116.9 |
| TOTAL | $6613.9 | $5981.4 | $5522.3 |

a Estimate. b Actual. Note: Obligations. Source: National Aeronautics & Space Administration

and astronomy, planetary exploration, and life sciences research. Specific projects slated for some funding increases include the space telescope (up $16 million to about $138 million), to be launched from the shuttle in 1985, and the international solar polar mission (up $16 million to $21 million), which was almost eliminated in last year's cuts. Funding for experiments in life sciences on the shuttle would get an increase of $14 million to $24 million for fiscal 1983, and the funds for payload development aboard the shuttle would more than double from $40 million to $81.4 million next year.

Funds for space applications R&D would fall somewhat, mostly because of a sharp drop in technology transfer funds, cuts in funds for payload development, materials processing in space aboard spacelab, and applied research in communications and information systems.

For the future, Beggs says the agency is looking at the possibility of unmanned space platforms in low Earth orbit or geosynchronous orbit, and at a permanently manned space facility in low Earth orbit.

The Department of Health & Human Services would get about $4.0 billion, a 4% increase, for R&D in the proposed budget, almost all of which would support research at the National Institutes of Health. The institutes are scheduled for a minuscule increase of less than $38.5 million, or 1.1%, to $3.5 billion. According to the Administration, this budget level would permit NIH to fund more than 15,000 research grants for 1983. But that may not occur. A year ago NIH officials were concerned about their ability to continue to grant that many awards, and now, with a budget increase below the rate of inflation, the number of grants may have to fall to keep them large enough to support high-quality research.

Among the individual institutes, funding for the Cancer Institute was cut 3% to $956 million and it was the only institute whose funding was actually reduced. Others received

## NSF chemistry funding is broken down along these lines

| $ Millions | 1982[a] | 1983[a] | 1981[b] | % change 1982–83 |
|---|---|---|---|---|
| Structural chemistry and thermodynamics | $13.3 | $12.2 | $11.7 | 9.0% |
| Chemical dynamics | 13.0 | 11.9 | 11.2 | 9.2 |
| Chemical physics | 11.0 | 10.1 | 9.6 | 8.9 |
| Synthetic organic and natural products chemistry | 7.9 | 7.3 | 6.9 | 8.2 |
| Synthetic inorganic and organometallic chemistry | 7.6 | 7.0 | 6.6 | 8.6 |
| Chemical analysis | 7.5 | 6.9 | 6.6 | 8.7 |
| Chemical instrumentation | 5.6 | 5.3 | 5.1 | 9.4 |
| TOTAL | $66.1 | $60.7 | $57.7 | 8.9% |

a Estimate. b Actual. Note: Obligations. Source: National Science Foundation

## Defense R&D up more than 20%

| $ Millions | 1983[a] | 1982[a] | 1981[b] |
|---|---|---|---|
| Tactical programs | $ 7,575.7 | $ 6,399.7 | $ 6,129.7 |
| Strategic programs | 6,647.1 | 4,596.4 | 3,440.4 |
| Technology base | 3,336.9 | 2,907.1 | 2,600.1 |
| Program management and support | 2,972.6 | 2,655.9 | 2,237.9 |
| Intelligence and communications | 2,772.5 | 2,202.0 | 1,832.1 |
| Advanced technology development | 951.7 | 735.4 | 593.3 |
| TOTAL | $24,256.5 | $19,496.5 | $16,833.5 |

a Estimate. b Actual. Note: Obligations. Source: Office of Management & Budget

## USDA research continues to increase

| $ Millions | 1983[a] | 1982[a] | 1981[b] |
|---|---|---|---|
| Agricultural Research Service | $ 470.5 | $436.3 | $420.5 |
| Cooperative State Research Service | 232.1 | 221.2 | 200.9 |
| Extension Service | 311.8 | 313.7 | 303.8 |
| National Agricultural Library | 9.0 | 8.3 | 8.4 |
| TOTAL | $1023.5 | $979.5 | $933.6 |

a Estimate. b Actual. Note: Obligations. Source: Department of Agriculture

## Small increase at NIH won't cover inflation

| $ Millions | 1983[a] | 1982[a] | 1981[b] |
|---|---|---|---|
| National Institutes | $3462.3 | $3423.8 | $3298.3 |
| Cancer | 955.9 | 987.1 | 989.5 |
| Heart, Lung & Blood | 577.3 | 559.8 | 550.1 |
| Arthritis, Diabetes & Digestive & Kidney Disease | 379.4 | 368.2 | 369.3 |
| General Medical Sciences | 345.6 | 339.9 | 333.5 |
| Neurological & Communicative Disorders & Stroke | 274.6 | 266.0 | 252.2 |
| Allergy & Infectious Diseases | 247.4 | 237.5 | 232.2 |
| Child Health & Human Development | 233.6 | 226.3 | 220.4 |
| Environmental Health Sciences | 157.8 | 154.6 | 96.6 |
| Eye | 131.5 | 130.4 | 117.7 |
| Aging | 84.6 | 81.9 | 75.6 |
| Dental Research | 74.6 | 72.1 | 71.2 |
| Research Resources | 192.3 | 185.4 | 176.6 |
| National Institute for Occupational Safety & Health | 49.5 | 60.3 | 102.4 |
| National Library of Medicine | 48.0 | 47.9 | 48.7 |
| Office of the director | 35.4 | 33.7 | 32.3 |
| Research facilities | 17.5 | 21.5 | 17.0 |
| John E. Fogarty Center | 12.7 | 11.7 | 9.6 |
| TOTAL | $4008.0 | $3784.3 | $3692.9 |

a Estimate. b Actual. Note: Obligations. Source: Office of Management & Budget

## Research at EPA takes another large drop

| $ Millions | 1983[a] | 1982[a] | 1981[b] |
|---|---|---|---|
| Air | $ 47.2 | $ 55.7 | $ 59.0 |
| Energy | 34.5 | 52.5 | 84.1 |
| Hazardous waste | 29.6 | 29.5 | 28.3 |
| Water quality | 27.7 | 45.1 | 49.9 |
| Toxic substances | 26.6 | 31.2 | 30.0 |
| Drinking water | 22.9 | 28.3 | 21.8 |
| Program management | 8.7 | 7.9 | 8.4 |
| Pesticides | 6.5 | 5.6 | 7.9 |
| Superfund | 6.4 | 13.9 | 4.7 |
| Interdisciplinary | 4.2 | 5.7 | 6.1 |
| Radiation | 1.6 | 2.5 | 2.4 |
| TOTAL | $215.9 | $277.9 | $302.6 |

a Estimate. b Actual. Note: Obligations. Source: Environmental Protection Agency

small increases—from about $1 million for the Eye Institute to more than $17 million for Heart, Lung, & Blood.

The Administration lists some activities considered significant that would be undertaken by NIH for 1983. These include clinical trials of new antiviral drugs against herpes, basic research on diabetes, research on epidemiology and risk estimation, and test development on reproductive toxicology, fertility assessment, and neurological toxicology.

As National Science Foundation director John B. Slaughter says, "within the context of the President's overall budget plans, I feel the NSF budget is a strong one" albeit "tightly constructed." This tight budget means that projects of lesser scientific promise or urgency will have to be postponed, extended, or in some instances phased out in order to focus available resources on projects of the highest merit and potential significance, NSF warns. One project that is being terminated is the Ocean Margin Drilling program, because of lack of interest from the oil industry which was expected to share the cost of the program on an equal basis.

Overall, NSF's budget would be up 7.7% to $1.1 billion. Obligations for research and related activities would be up 8.7% to just under $1.1 billion. But the science and engineering education budget almost would be gone; it would be down 28% to $15 million. That amount would go solely for graduate fellowships and would support 1390 new and continuing fellows at an annual stipend of $6900, plus a cost of education allowance of $4000 per year.

There are no major new initiatives in NSF's proposed budget (in fact, it calls for a 5% reduction in NSF staff), but a number of old initiatives would continue to be supported. Although no separate instrumentation improvement budget was included as was proposed last January, NSF expects to increase its funding of major equipment purchases by 31% to $10.2 million.

Funding for other equipment and instrumentation would rise 9% to $85.1 million, slightly less than in fiscal 1981. For the most part, equipment purchases would be funded as part of regular research grants.

In addition, the proposed budget would provide for funding of one new industry/university cooperative research center, bringing the total to six; a 9% increase to $6 million in funding for industry/university cooperative research projects; a 10% increase to $5.5 million for small business innovation research; and a 50% increase in the minority research initiation program, to $2.5 million.

Funding for the mathematical and physical sciences directorate would be up 9.5% to almost $299 million, with funding for chemical research up 8.9% to $66.1 million. The $5.4 million increase would be spread fairly evenly among all the chemistry program areas. Within the directorate, overall support for individual project research would be increased about 8% to maintain approximately a constant level of effort across all disciplines.

Within the biological, behavioral, and social sciences directorate, funding for the social and economic sciences, which was scheduled to be terminated and then was rescued last year, would be held essentially level at $17.8 million, 30% less than was provided in fiscal 1981.

The Department of Agriculture is the sixth largest federal funding agency for R&D under the proposed fiscal 1983 budget. With just over $1 billion for R&D next year, the Administration would give USDA a 4.5% hike over the 1982 figure. Agriculture is also one of the few R&D agencies whose funding would not be cut back from 1982 revisions made by the Administration. The proposed increase for 1983 shows there is an ongoing commitment to agricultural research, much of it in basic research, but there would be some changes in emphasis.

The largest portion of the funds would go to USDA's in-house research program, the Agricultural Research Service. ARS support is proposed at almost $471 million for 1983, an 8% increase above fiscal 1982. Most of the ARS work is in basic and developmental research in cooperation with the state experiment stations. Major programs for 1983 would include improvement of plant and animal production efficiency, use and improvement of natural resources, and protection of plants and animals from pests. An area slated for a large increase is research on acid precipitation, surging from only $110,000 in fiscal 1982 to just under $1 million for 1983. The only cutback at ARS would be in tropical and subtropical research, dropping 80% to $735,000 in 1983.

A smaller net gain has been proposed for USDA's cooperative state research service. Nearly $11 million would be added, raising the total to $232 million. These funds are mostly handed out by a formula to land-grant universities to do agricultural research. The competitive grants portion of the program, however, would get a big increase—up 40% to $22.9 million in 1983. Much of this would be targeted to basic plant science. Also included in the budget would be about $9 million for improvement of research equipment and facilities at the 17 land-grant colleges and the Tuskegee Institute—the first installment of a five-year, $50 million program.

The third major section of USDA's R&D work is the extension service, which acts like a technology clearinghouse for farm, local, and community agriculture problems. A small decrease in funding is proposed for this work, down $1.8 million to $312 million for fiscal 1983. This small change may reflect the beginning of an Administration move to get the states to fund more of this kind of service in the future.

R&D funding at the Environmental Protection Agency has been the subject of intense speculation for months. And even with Administration figures, the impact of the changes is not clear. Different numbers from OMB and EPA for what R&D funding will be, different starting figures because of fiscal 1981 rescissions and deferrals and fiscal 1982 multiple revisions make it very hard to get a handle on what the true figures are.

But, whatever yardstick is used, the trend is down—way down. EPA says its R&D budget would be 23.3% lower for 1983 than in 1982, to $216 million. The fiscal 1982 number was the subject of much trimming last year, as was the fiscal 1981 R&D budget. Just about every category would have reduced funding. Only funding for hazardous waste research, a kind of showplace for the Administration, would stay the same at $30 million. Pesticide research funding, however, would increase 16% to $6.5 million.

According to EPA, this reduced R&D program still would permit the agency to fulfill the needs of the laws it administers. This can be done, EPA officials claim, because of a shift in the attitude toward research at EPA. From now on, EPA's research will be directed only toward meeting its regulatory needs, it says. In other words, research not immediately useful to EPA will be eliminated. An example of this would be large reductions in funds for air quality modeling research because, EPA says, the models being developed were much too complex for the needs of the states using them.

One justification given for lower funding is that additional research in some areas is no longer needed by EPA. Examples cited include a much slower pace for research on pollution from synthetic fuels plants and the expected completion of some conventional combustion technology projects in fiscal 1982. Other reasons are the completion of an epidemiology program in the drinking water area and the expected end to research on effluent guidelines and priority pollutants in water. Superfund research also is slowing, with a $7.5 million reduction set for 1983 because of the fast startup of that program and the assumption that the development of cleanup protocols for abandoned waste dumps will be finished this year.

Responding to some persistent rumors of mass firings at EPA in 1982 that would completely gut the agency, EPA Administrator Anne M. Gorsuch wrote to all EPA staff members that there would be no involuntary terminations at EPA for the rest of fiscal 1982. Still, EPA is counting on continuation of its high rate of attrition to get down to about 8700 employees, a drop of almost 1200 from 1981. R&D staff is expected to lose about 250 permanent employees before fiscal 1983, leaving a total of 1300. It is curious, however, that during a time of reductions in staff and claims that the agency is topheavy with management, that the budget for R&D program management could rise 10% as the rest of the R&D budget falls.

Congress of course will alter the proposed budget figures before they are made final, but there is hope in Washington that the Administration will not keep changing the game plan as it did last year. And it is not likely to. This budget is the Reagan Administration's product from start to finish. However, if the size of the deficit prompts Congress to take up the budget ax, then those programs which got increases when others didn't offer tempting targets. □

# New recession torpedoes chemical earnings

**An unexpected economic dip hit an already weakened U.S. chemical industry in fourth quarter, triggering at least six months of poor profits**

William J. Storck, C&EN, New York, and William F. Fallwell, C&EN, Washington

The U.S. chemical industry has been dealt a severe economic blow. Just as it had begun to recover last year from the 1980 recession, the industry was hit in the fourth quarter by a new recession that was unexpected, worldwide, and very damaging.

Many chemical companies and product lines escaping trouble in 1980 were trapped the second time. The new recession shows every sign of extending at least through the first quarter of 1982.

The outcome has been a sharp change in the chemical industry's financial results beginning with the final three months of 1981. After managing two quarters of improved year-to-year earnings, basic chemical companies headed back into declining figures in the fourth quarter.

As a result, full-year 1981 earnings hardly budged from 1980, coming in lower than the most pessimistic forecasts and embarrassingly wide of the more optimistic targets. The profits outlook for 1982 is more of the same, at least through mid-year. All talk of recovery in the industry starts with the second half.

So the chemical and most other U.S. industries indeed now have their "double dip," the repeat recession forecast by a few maverick economists a year ago and widely derided in business circles. The main trigger was a renewed interest-rate spiral, especially painful for big-ticket consumer durables markets such as autos and housing. However, the financial impact on chemicals was exacerbated by chemicals' own problems of low plant capacity use, heavy price discounts, a reversal in foreign trade, and, to the surprise of many, excessive plant investment.

The main question now is, when will all this bottom out? Straws from the heart of the chemical industry this winter show only further decline, although production sources hope that the slide will end by spring. A telltale sign is renewed weakness in man-made fibers, an early warning product group, after some reports of firming around year's end. More indications of continuing poor business are drastically discounted prices in major products, including basic olefins, aromatics, plastics, and fertilizer. These clues are borne out by the first

## Chemical industry leaders for fourth quarter . . .

| Sales | | | Earnings[a] | | | Profitability | | |
|---|---|---|---|---|---|---|---|---|
| Rank | $ Millions | Rank 1980 | | $ Millions | Rank 1980 | | Earnings as % of sales | Rank 1980 |
| 1 Du Pont[b] | $3440.0 | 1 | Du Pont[b] | $159.0 | 1 | Freeport-McMoRan | 15.3% | 1 |
| 2 Dow Chemical | 2965.0 | 2 | Union Carbide | 139.8 | 3 | Nalco Chemical | 12.0 | 2 |
| 3 Union Carbide | 2430.0 | 3 | Allied Corp. | 92.0 | 4 | International Flavors | 11.1 | 3 |
| 4 W. R. Grace | 1759.3 | 4 | W. R. Grace | 81.7 | 5 | Petrolite | 9.9 | 4 |
| 5 Allied Corp. | 1696.0 | 6 | Dow Chemical | 66.5 | 2 | Air Products | 9.3 | 5 |
| 6 Monsanto | 1558.2 | 5 | Diamond Shamrock | 59.7 | 7 | Loctite | 7.6 | 9 |
| 7 American Cyanamid | 927.1 | 7 | Monsanto | 51.8 | 9 | Diamond Shamrock | 6.8 | 13 |
| 8 Celanese | 884.0 | 8 | American Cyanamid | 48.4 | 8 | International Minerals | 6.8 | 8 |
| 9 Diamond Shamrock | 872.5 | 9 | PPG Industries | 39.1 | 6 | Stauffer Chemical | 6.6 | 13 |
| 10 PPG Industries | 803.8 | 10 | Celanese | 35.1 | 10 | First Mississippi | 6.5 | 7 |

## . . . and for full-year 1981

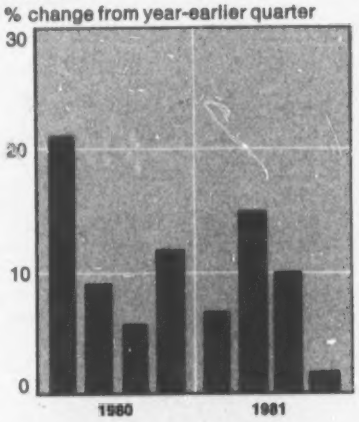
| Sales | | | Earnings[a] | | | Profitability | | |
|---|---|---|---|---|---|---|---|---|
| Rank | $ Millions | Rank 1980 | | $ Millions | Rank 1980 | | Earnings as % of sales | Rank 1980 |
| 1 Du Pont[b] | $14,700.0 | 1 | Du Pont[b] | $797.0 | 1 | Freeport-McMoRan | 19.0% | 1 |
| 2 Dow Chemical | 11,872.7 | 2 | Union Carbide | 649.0 | 3 | International Flavors | 14.6 | 2 |
| 3 Union Carbide | 10,170.0 | 3 | Dow Chemical | 563.5 | 2 | Nalco Chemical | 12.2 | 3 |
| 4 Monsanto | 6,947.6 | 4 | Monsanto | 377.5 | 6 | Petrolite | 9.4 | 4 |
| 5 W. R. Grace | 6,520.8 | 5 | Allied Corp. | 343.0 | 4 | Stauffer Chemical | 8.7 | 10 |
| 6 Allied Corp. | 6,407.0 | 6 | W. R. Grace | 326.4 | 5 | Air Products | 8.1 | 8 |
| 7 Celanese | 3,752.0 | 8 | Diamond Shamrock | 230.2 | 7 | Diamond Shamrock | 6.8 | 11 |
| 8 American Cyanamid | 3,649.1 | 7 | PPG Industries | 211.2 | 8 | First Mississippi | 6.8 | 6 |
| 9 PPG Industries | 3,400.0 | 9 | American Cyanamid | 197.1 | 11 | Union Carbide | 6.4 | 12 |
| 10 Diamond Shamrock | 3,376.2 | 10 | Freeport-McMoRan | 159.0 | 10 | PPG Industries | 6.2 | 14 |
| | | | | | | Loctite | 6.2 | 7 |

a After taxes. b Excludes Conoco. **Note:** For 40 chemical companies listed on page 18.

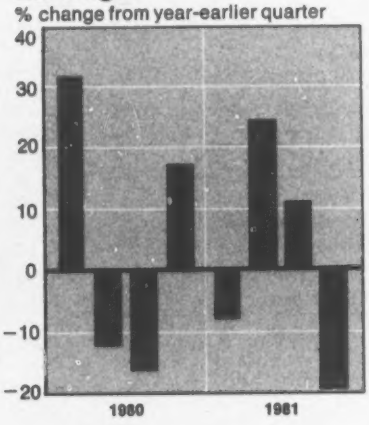
# Chemical industry 1981 fourth-quarter results

- Sales were almost flat
- Earnings fell
- Profit margins dropped
- Production slipped 4.6%
- Prices rose 9.8%

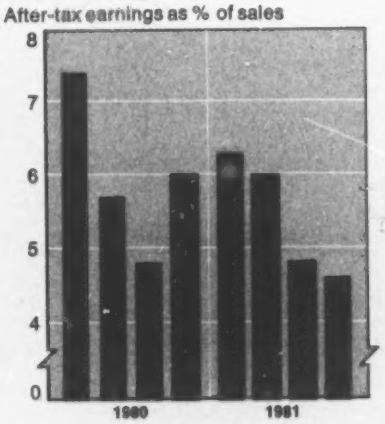
**Sales**
% change from year-earlier quarter



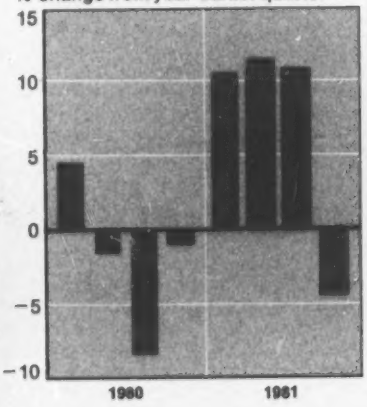

**Earnings**
% change from year-earlier quarter



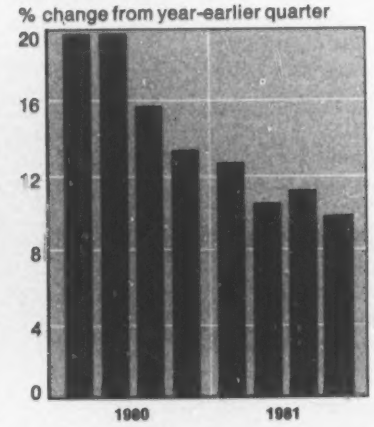

**Profit margins**
After-tax earnings as % of sales




**Production**
% change from year-earlier quarter

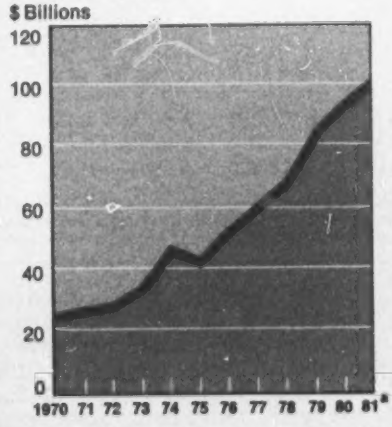



**Prices**
% change from year-earlier quarter

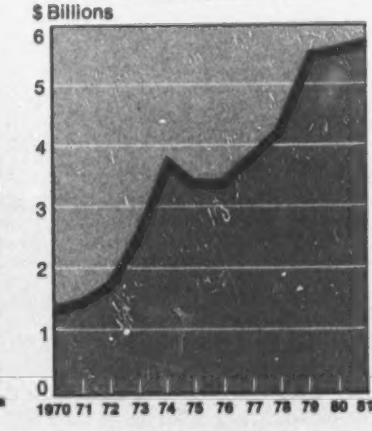



## Sales increased 7% in 1981 to top $100 billion; earnings were almost flat; and profit margins decreased to 5.6%

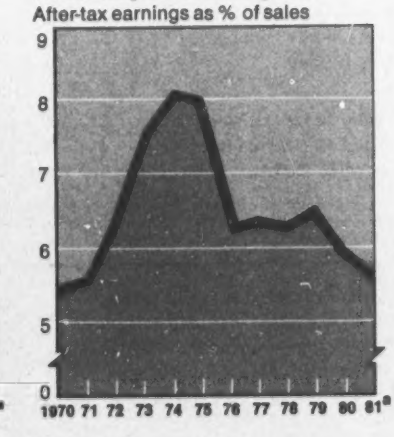
**Annual sales**
$ Billions




**Annual earnings**
$ Billions




**Annual profit margins**
After-tax earnings as % of sales




a C&EN estimates. **Note:** All sales, earnings, and profit margin data are based on the combined performance of the 40 largest chemical makers listed on page 18.

## Earnings at chemical companies took a drubbing in fourth-quarter 1981

| | FOURTH-QUARTER 1981 | | | | | | FULL-YEAR 1981 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sales ($ millions) | Earnings ($ millions) | Change from 1980 Sales | Change from 1980 Earnings | Profit margin[a] 1981 | Profit margin[a] 1980 | Sales ($ millions) | Earnings ($ millions) | Change from 1980 Sales | Change from 1980 Earnings |
| Du Pont[d] | $ 3,440.0 | $ 159.0 | −2% | −18% | 4.6% | 5.5% | $ 14,700.0 | $ 797.0 | 7% | 17% |
| Dow Chemical | 2,985.0 | 66.5 | 8 | −73 | 2.2 | 8.7 | 11,872.7 | 563.5 | 12 | −30 |
| Union Carbide | 2,430.0 | 139.8 | −9 | −6 | 6.0 | 5.6 | 10,170.0 | 649.0 | 2 | −4 |
| W. R. Grace[e] | 1,759.3 | 81.7 | 3 | 20 | 4.6 | 4.0 | 6,520.8 | 326.4 | 6 | 26 |
| Allied Corp.[f] | 1,696.0 | 92.0 | 17 | −4 | 5.4 | 6.6 | 6,407.0 | 343.0 | 16 | 13 |
| Monsanto[g] | 1,558.2 | 51.8 | −6 | 31 | 3.3 | 2.4 | 6,947.6 | 377.5 | 6 | 47 |
| American Cyanamid | 927.1 | 48.4 | 1 | nc | 5.2 | 5.3 | 3,649.1 | 197.1 | 6 | 24 |
| Celanese | 884.0 | 35.0 | −3 | −10 | 4.0 | 4.3 | 3,752.0 | 144.0 | 12 | 18 |
| Diamond Shamrock | 872.5 | 59.7 | 3 | 9 | 6.8 | 6.4 | 3,376.2 | 230.2 | 7 | 8 |
| PPG Industries | 803.8 | 39.1 | −5 | −42 | 4.9 | 8.0 | 3,400.0 | 211.2 | 6 | 1 |
| B. F. Goodrich[h] | — | — | — | — | — | 2.9 | — | — | — | — |
| Hercules[i] | 649.0 | 27.4 | 3 | −12 | 4.2 | 4.9 | 2,718.0 | 147.4 | 9 | 29 |
| Olin[j] | 445.2 | 13.8 | −5 | 10 | 3.1 | 2.7 | 2,001.3 | 92.8 | 7 | 26 |
| Ethyl Corp. | 430.3 | 23.9 | nc | −3 | 5.6 | 5.7 | 1,757.2 | 90.9 | 1 | 1 |
| Williams Cos.[k] | 423.9 | 6.1 | −15 | −81 | 1.4 | 6.4 | 1,976.3 | 99.2 | −5 | −28 |
| Rohm & Haas | 412.5 | 13.9 | −1 | −18 | 3.4 | 4.1 | 1,884.7 | 96.8 | 9 | 3 |
| International Minerals[l] | 409.1 | 28.0 | −17 | −33 | 6.8 | 8.4 | 1,940.8 | 144.7 | nc | −17 |
| Stauffer Chemical[m] | 376.5 | 24.7 | −12 | −10 | 6.6 | 6.4 | 1,726.2 | 149.9 | 2 | 24 |
| Air Products[n] | 373.6 | 34.6 | 2 | 7 | 9.3 | 8.8 | 1,577.2 | 128.3 | 7 | 10 |
| Witco Chemical | 306.7 | 11.2 | −2 | 1 | 3.7 | 3.3 | 1,291.9 | 38.6 | 10 | 6 |
| Akzona | 276.5 | −2.2 | −1 | def | def | 0.7 | 1,187.6 | 11.6 | 13 | 138 |
| Pennwalt | 250.5 | −2.7 | −5 | def | def | 4.1 | 1,056.1 | 36.7 | 1 | −7 |
| Reichhold Chemicals | 210.9 | 1.5 | −5 | −79 | 0.7 | 3.2 | 950.0 | 17.1 | 7 | 6 |
| Lubrizol[h] | — | — | — | — | — | 10.7 | — | — | — | — |
| Freeport-McMoRan | 199.8 | 30.6 | 5 | −21 | 15.3 | 20.2 | 835.4 | 159.0 | 19 | −2 |
| Thiokol[h] | — | — | — | — | — | 4.5 | — | — | — | — |
| Nalco Chemical | 177.6 | 21.3 | 9 | 6 | 12.0 | 12.4 | 666.6 | 81.2 | 8 | 12 |
| Mallinckrodt[h] | — | — | — | — | — | 3.5 | — | — | — | — |
| International Flavors | 97.9 | 7.6 | 2 | −28 | 7.8 | 11.1 | 451.1 | 66.1 | 1 | 5 |
| Liquid Air[h] | — | — | — | — | — | 6.3 | — | — | — | — |
| Chemed[h] | — | — | — | — | — | 7.4 | — | — | — | — |
| First Mississippi | 95.6 | 6.2 | −3 | −26 | 6.5 | 8.5 | 350.1 | 23.7 | 19 | −7 |
| H. B. Fuller Co. | 82.4 | 3.2 | 5 | 6 | 3.9 | 3.8 | 328.7 | 13.6 | 11 | 53 |
| Petrolite | 77.1 | 7.6 | 20 | 29 | 9.9 | 9.2 | 297.2 | 27.8 | 17 | 12 |
| Crompton & Knowles | 56.6 | 2.7 | −7 | 8 | 4.8 | 4.1 | 243.4 | 8.6 | 1 | 12 |
| Loctite | 52.7 | 4.0 | nc | −7 | 7.6 | 8.1 | 219.5 | 13.5 | 8 | −21 |
| Stepan Chemical[h] | — | — | — | — | — | 3.2 | — | — | — | — |
| Essex Chemical[h] | — | — | — | — | — | 4.3 | — | — | — | — |
| Great Lakes Chemical[h] | — | — | — | — | — | 15.6 | — | — | — | — |
| Philip A. Hunt | 29.6 | −0.8 | 11 | def | def | def | 111.9 | 3.8 | 5 | −5 |
| **Total 19 largest companies** | $21,182.7 | $ 956.6 | −0.8% | −21.9% | 4.5% | 5.7% | $87,669.0 | $4827.5 | 7.1% | 3.3% |
| **Total 12 other companies** | $ 1,607.2 | $ 79.0 | 0.8% | −29.8% | 4.9% | 7.1% | $ 6,697.7 | $ 462.7 | 9.0% | 3.7% |
| **GRAND TOTAL** | $22,789.9 | $1035.6 | −0.7% | −22.6% | 4.5% | 5.8% | $94,366.7 | $5290.2 | 7.3% | 3.3% |

a After-tax income as percentage of sales. b Fully diluted before nonrecurring items and extraordinary charges for operations. c As of Jan. 29. d Excludes Conoco results. e Excludes $34.9 million nonrecurring gain for 1981. f Excludes $33 million nonrecurring gain for fourth-quarter 1981, $5 million nonrecurring gain for full-year 1981, and $14 million nonrecurring loss in fourth-quarter 1980. g Excludes nonrecurring $67.7 million gain for 1981. h Not all information available at press time. i Excludes nonrecurring loss of $9.4 million in fourth-quarter 1981.

systematic survey of 1982 from the National Association of Purchasing Management, which finds that January brought further, although slower, decline than the previous few months.

In the fourth quarter, the bottom dropped out for the 31 U.S. chemical companies that have reported so far of the 40 largest chemical firms tracked by C&EN. Combined sales for the 31 dropped almost 1% to $22.8 billion in the fourth quarter. However, earnings for the 31 plunged 23% to $1.04 billion. As a result, profit margins for the group sank to 4.5% from 5.8% in the final three months of 1980.

It is almost surprising that the earnings and sales drops were not greater than they were, considering the breadth of poor results among the chemical companies that have reported. Of the 31, sales of 16 of them fell, and earnings of 20 of them dropped. The falling sales ranged from 1% at Rohm & Haas and Akzona to 17% at International Minerals & Chemical. The earnings decline was even more pronounced, ranging from

| FULL-YEAR 1981 Profit margin[a] 1981 | 1980 | Earnings per share[b] 4th qtr | Recent 12 months | STOCK MARKET DATA[c] Jan 29 | Recent 12 months High | Low | Price earnings ratio Jan. 29 | Annual indicated dividend | Dividend yield, % of price |
|---|---|---|---|---|---|---|---|---|---|
| 5.4% | 5.0% | na | na | $36¼ | $56 | $35⅛ | na | $2.40 | 6.6% |
| 4.7 | 7.6 | $0.35 | $3.00 | 24¼ | 39 | 23¼ | 8 | 1.80 | 7.4 |
| 6.4 | 6.7 | 2.04 | 9.56 | 47¼ | 62⅛ | 45¼ | 5 | 3.40 | 7.2 |
| 5.5 | 4.7 | 1.68 | 6.72 | 45¼ | 54⅞ | 38½ | 7 | 2.60 | 5.7 |
| 5.4 | 5.5 | 2.28 | 9.03 | 43¾ | 59⅞ | 39 | 5 | 2.40 | 5.5 |
| 5.4 | 3.9 | 1.25 | 9.75 | 68⅞ | 87½ | 59½ | 7 | 3.80 | 5.5 |
| 5.4 | 4.6 | 1.01 | 4.11 | 27½ | 36½ | 24½ | 6 | 1.75 | 6.4 |
| 3.8 | 3.6 | 2.05 | 8.52 | 54½ | 69¼ | 51⅜ | 6 | 4.00 | 7.3 |
| 6.8 | 6.8 | 0.96 | 3.68 | 24⅛ | 39⅝ | 23 | 7 | 1.76 | 7.3 |
| 6.2 | 6.5 | 1.15 | 6.34 | 33⅜ | 58¼ | 31½ | 5 | 2.36 | 7.1 |
| — | 2.0 | — | — | 20⅝ | 28⅛ | 18½ | 5 | 1.56 | 7.6 |
| 5.4 | 4.6 | 0.65 | 3.36 | 20⅞ | 26⅜ | 19⅛ | 6 | 1.32 | 6.3 |
| 4.6 | 4.0 | 0.59 | 3.88 | 21¾ | 27 | 19⅜ | 6 | 1.20 | 5.5 |
| 5.2 | 5.2 | 1.20 | 4.56 | 21⅜ | 34½ | 20 | 5 | 1.50 | 7.0 |
| 5.0 | 6.7 | 0.21 | 3.67 | 28⅜ | 46⅜ | 22¼ | 8 | 1.20 | 4.2 |
| 5.1 | 5.4 | 1.08 | 7.51 | 57 | 71¾ | 51⅞ | 8 | 2.80 | 4.9 |
| 7.5 | 9.0 | 1.05 | 5.31 | 31½ | 64 | 30⅜ | 6 | 2.60 | 8.3 |
| 8.7 | 7.2 | 0.56 | 3.41 | 21¾ | 27¾ | 18¾ | 6 | 1.32 | 6.1 |
| 8.1 | 7.9 | 1.21 | 4.50 | 35⅛ | 48⅞ | 32½ | 8 | 0.80 | 2.3 |
| 3.0 | 3.5 | 1.20 | 4.14 | 23¼ | 31½ | 22⅜ | 6 | 1.80 | 7.7 |
| 1.0 | 0.5 | −0.18 | 0.95 | 10½ | 15½ | 9¼ | 11 | 0.80 | 7.6 |
| 3.5 | 3.8 | −0.26 | 3.55 | 24¾ | 36 | 24¼ | 7 | 2.20 | 8.9 |
| 1.8 | 1.8 | 0.12 | 2.04 | 11⅛ | 16 | 10⅝ | 5 | 0.48 | 4.3 |
| — | 12.1 | — | — | 23½ | 35½ | 20⅜ | 12 | 1.08 | 4.6 |
| 19.0 | 23.1 | 0.44 | 2.30 | 21⅛ | 40½ | 18 | 9 | 0.60 | 2.8 |
| — | 4.6 | — | — | 29¾ | 39 | 26½ | 10 | 1.10 | 3.7 |
| 12.2 | 11.7 | 1.07 | 4.04 | 49¼ | 58¼ | 41 | 12 | 2.00 | 4.1 |
| — | 8.1 | — | — | 47½ | 49⅜ | 31½ | 14 | 1.00 | 2.1 |
| 14.6 | 14.1 | 0.21 | 1.81 | 19½ | 22⅜ | 17⅞ | 11 | 1.00 | 5.1 |
| — | 7.2 | — | — | 16½ | 29¼ | 16½ | 7 | 1.60 | 9.7 |
| — | 8.8 | — | — | 23¼ | 25⅛ | 19 | 8 | 1.14 | 4.9 |
| 6.8 | 8.7 | 0.29 | 1.11 | 13⅛ | 24⅞ | 12⅛ | 12 | 0.24 | 1.8 |
| 4.1 | 3.0 | 0.70 | 2.97 | 21¾ | 26½ | 13 | 7 | 0.48 | 2.2 |
| 9.4 | 9.8 | 0.64 | 2.33 | 24¼ | 24¼ | 16½ | 10 | 1.20 | 4.9 |
| 3.5 | 3.2 | 0.78 | 2.51 | 17 | 18¾ | 13½ | 7 | 1.04 | 6.1 |
| 6.2 | 8.7 | 0.40 | 1.36 | 22¼ | 30 | 18⅛ | 16 | 0.56 | 2.5 |
| — | 2.3 | — | — | 16⅜ | 21⅞ | 13⅛ | 5 | — | — |
| — | 3.6 | — | — | 16¾ | 20¼ | 13½ | 6 | 0.80 | 4.8 |
| — | 14.9 | — | — | 37¾ | 58½ | 34⅜ | 14 | 0.48 | 1.3 |
| 3.3 | 3.8 | −0.15 | 0.67 | 9½ | 12⅛ | 8⅜ | 14 | 0.40 | 4.2 |
| **5.5%** | **5.7%** | | | | | | | | |
| **6.9%** | **7.3%** | | | | | | | | |
| **5.6%** | **5.8%** | | | | | | | | |

j Excludes nonrecurring charge of $40 million in fourth-quarter 1980. k Excludes nonrecurring charge of $3.7 million in 1981. l Excludes nonrecurring gain of $41.3 million in fourth-quarter 1981. m Excludes nonrecurring gain of $14.9 million in fourth-quarter 1980. n Excludes $61.9 million nonrecurring gain in fourth-quarter 1981. def = deficit. na = not applicable. nc = no change.

a drop of just 3% at Ethyl Corp. to 73% at Dow Chemical and 79% at Reichhold Chemicals to losses at Akzona, Pennwalt, and Philip A. Hunt.

Oddly, the drops in earnings were less pronounced at the 19 largest (and usually more basic) chemical companies than among the smaller, more specialty-oriented companies. The larger companies had a combined earnings fall of about 22% from the year-earlier quarter to $957 million. This was on an almost 1% reduction in sales to $21.2 billion.

The 12 smaller companies, dragged down by the losses at Akzona, Pennwalt, and Philip A. Hunt, showed a fourth-quarter earnings drop of 30% to $79.0 million. Sales for the smaller group increased, but only 0.8% to $1.61 billion.

As a result of the poor showing in the fourth quarter, chemical companies had a lackluster year, with profits increasing only slightly. Combined earnings for the 31 chemical companies increased only 3.3% in 1981 to $5.29 billion. Sales during the year climbed about 7.3% to $94.4 bil-

## Earnings slump at many chemical-producing oil and gas companies

| | % chemical sales | FOURTH-QUARTER 1981 Sales ($ millions) | Earnings ($ millions) | Change from 1980 Sales | Change from 1980 Earnings | Profit margin[a] 1981 | Profit margin[a] 1980 | FULL-YEAR 1981 Sales ($ millions) | Earnings ($ millions) | Change from 1980 Sales |
|---|---|---|---|---|---|---|---|---|---|---|
| Exxon | 7% | $29,583.0 | $1065.0 | −1% | −21% | 3.6% | 4.5% | $114,989.0 | $5565.0 | 4% |
| Mobil[b] | 3 | 18,024.0 | 588.0 | 4 | 5 | 3.3 | 3.2 | 68,516.0 | 2434.0 | 8 |
| Texaco[b] | 3 | 14,700.0 | 507.0 | 4 | 1 | 3.4 | 3.5 | 59,400.0 | 2310.0 | 13 |
| Standard Oil of California | 3 | 11,900.0 | 571.0 | 10 | −7 | 4.8 | 5.7 | 45,200.0 | 2380.0 | 9 |
| Gulf Oil[b] | 10 | 7,957.0 | 301.0 | 4 | −1 | 3.8 | 4.0 | 30,461.0 | 1231.0 | 6 |
| Standard Oil (Ind.)[b] | 9 | 7,800.0 | 384.0 | 1 | −5 | 4.9 | 5.2 | 31,700.0 | 1841.8 | 14 |
| Atlantic Richfield[b] | 8 | 7,140.3 | 469.8 | −3 | 18 | 6.6 | 5.4 | 28,208.3 | 1671.3 | 17 |
| Shell Oil | 16 | 5,193.0 | 458.0 | 1 | 12 | 8.8 | 8.0 | 21,739.0 | 1701.0 | 9 |
| Sun Co.[b] | 3 | 4,400.0 | 149.0 | 7 | 62 | 3.4 | 2.2 | 16,000.0 | 642.0 | 21 |
| Tenneco | 12 | 4,292.0 | 260.0 | 18 | 30 | 6.1 | 5.5 | 15,462.0 | 813.0 | 17 |
| Phillips Petroleum | 14 | 4,090.0 | 186.5 | 6 | −35 | 4.6 | 7.4 | 16,290.0 | 879.4 | 19 |
| Standard Oil (Ohio) | 4 | 3,704.4 | 477.8 | 21 | 0 | 12.9 | 15.5 | 13,810.9 | 1946.9 | 22 |
| Getty Oil | 2 | 3,472.8 | 216.5 | 17 | 3 | 6.2 | 7.1 | 13,251.6 | 856.9 | 27 |
| Union Oil[b] | 10 | 2,911.2 | 236.0 | 8 | 33 | 8.1 | 6.6 | 11,296.0 | 767.0 | 8 |
| Cities Service[b] | 7 | 2,223.9 | 31.4 | 7 | −73 | 1.4 | 5.7 | 8,564.4 | 286.4 | 15 |
| Kerr-McGee | 14 | 1,072.7 | 66.0 | 13 | 27 | 6.2 | 5.5 | 3,826.4 | 211.1 | 10 |
| American Petrofina | 15 | 531.2 | 17.0 | −14 | −12 | 3.2 | 3.1 | 2,522.2 | 47.1 | 20 |

a After-tax income as percentage of sales. b Excludes major nonrecurring earnings: Mobil—$459 million in first-quarter 1980; Texaco—$402 million in first-quarter 1980; Gulf Oil—$100 million in second-quarter 1980; Standard Oil (Ind.)—$80 million in third-quarter 1981; Atlantic Richfield—$115 million in third-quarter 1980; Sun Co.—$299 million in fourth-quarter

lion. Profit margins fell to 5.6% from 5.8% in 1980.

Unlike the fourth quarter, for the full year the smaller companies did a little better than the larger companies. Combined earnings for the 12 smaller firms were up 3.7% from 1980 to almost $463 million. Combined sales for the smaller companies increased 9.0% to $6.70 billion. But, because sales were increasing much faster than earnings, profitability fell. Profit margins for the smaller firms in 1981 averaged 6.9%, compared to 7.3% in 1980.

At the 19 larger firms, combined earnings increased 3.3% from 1980 to about $4.83 billion. Sales, meanwhile, rose 7.1% to about $87.67 billion. But, again, profit margins sank—to an average of 5.5% in 1981 from 5.7% the year before.

The main problems in the fourth quarter seem to be plastics, fibers, and foreign trade, including both declining export volumes and a negative impact on earnings in bringing money into the U.S. because of the higher value of the dollar against other currencies.

For instance, Allied Corp. indicates that income in the fibers and plastics area was sharply lower than in 1980 as a result of depressed housing and auto markets. Allied's earnings dropped 4% in the fourth quarter to $92 million, but sales increased 17% to almost $1.70 billion. However, income from fibers and plastics operations declined 59% in the fourth quarter to $9 million, and sales for these products dropped a more modest 11% to $271 million.

Dow Chemical, which suffered a whopping earnings drop of 73% to $66.5 million in the fourth quarter, also singled out low operating rates and poor pricing in plastics as one of its major problems in the final three months of 1981.

Fibers, seemingly always on the edge of a turnaround but never quite getting there, came in for their share of problems in the fourth quarter. For instance, the poor fibers market contributed mightily to the $2.2 million loss at Akzona in the fourth quarter.

And fibers aided the drop in earnings at Celanese. Overall, earnings at Celanese in the fourth quarter dropped 10% from the year before to $35 million.

Celanese's fiber earnings in the U.S. fell 18% in the fourth quarter to 71 cents a share, but overseas the situation was much worse. There Celanese's fiber earnings dropped to 6 cents a share from 16 cents a share in fourth-quarter 1980—a decline of almost 63%.

Only at Monsanto did fiber earnings seem to improve in the fourth quarter, but it was a case of the loss not being so great as it was the year before. The company had a loss on textile operations in the fourth quarter of $26.4 million, compared with a much greater loss of nearly $147 million in the fourth quarter of 1980.

The fertilizer markets, as they have in previous quarters, also contributed to lower earnings. At Freeport-McMoRan, agricultural minerals earnings fell about 25% in the fourth quarter, according to the company, principally as a result of a drop in sulfur sales of about 30% or 220,000 tons. Freeport also says that the U.S. chemical phosphate industry was operating at only about 66% of capacity in the fourth quarter, because of an intense cost-price squeeze on U.S. farmers.

And at Williams Cos. poor phosphate markets have hit the Agrico Chemical Co. subsidiary hard. For the full year, Agrico's operating profit declined to $35.1 million from $175.5 million in 1980.

The financial trouble for basic chemical companies in C&EN's fourth-quarter survey also spread to the rest of the chemical production sphere, including oil and other companies that are diversified into chemicals. Oil companies already had problems in both chemical and overall corporate performance before the fourth quarter. The other diversified chemical producers found the going much tougher in the fourth quarter than in their widely improved third quarter.

For 17 major chemical-producing oil and natural gas companies in

| FULL-YEAR 1981 | | | STOCK MARKET DATA | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Change from 1980 | Profit margin[a] | | Earnings per share | Recent 12 months | Stock price Jan. 29 | Recent 12 months High | Recent 12 months Low | Price-earnings ratio Jan. 29 | Annual indicated dividend | Dividend yield, % of price |
| Earnings | 1981 | 1980 | 4th qtr | | | | | | | |
| −2% | 4.8% | 5.1% | $1.22 | $6.43 | 30⅝ | 39¼ | 29⅜ | 5 | $3.00 | 9.8% |
| −13 | 3.6 | 4.4 | 1.38 | 5.72 | 23¾ | 39 | 22⅛ | 4 | 2.00 | 8.4 |
| 3 | 3.9 | 4.3 | 1.96 | 8.75 | 31½ | 43⅞ | 30⅛ | 4 | 3.00 | 9.5 |
| −1 | 5.3 | 5.8 | 1.67 | 6.96 | 36½ | 51¼ | 34¾ | 5 | 2.40 | 6.6 |
| −6 | 4.0 | 4.5 | 1.60 | 6.37 | 31⅞ | 41⅜ | 29⅞ | 5 | 2.80 | 8.8 |
| −4 | 5.8 | 6.9 | 1.29 | 6.29 | 45⅞ | 75½ | 43½ | 7 | 2.80 | 6.1 |
| 9 | 5.9 | 6.4 | 1.86 | 6.66 | 43 | 62¾ | 38¼ | 6 | 2.40 | 5.6 |
| 10 | 7.8 | 7.7 | 1.48 | 5.51 | 40 | 51½ | 35¼ | 7 | 1.80 | 4.5 |
| −18 | 4.0 | 5.9 | 1.19 | 5.13 | 37½ | 48¾ | 29 | 7 | 2.10 | 5.6 |
| 12 | 5.3 | 5.5 | 1.91 | 6.01 | 31⅞ | 49¾ | 28¾ | 5 | 2.60 | 8.2 |
| −18 | 5.4 | 7.8 | 1.23 | 5.78 | 39 | 56 | 33¾ | 7 | 2.20 | 5.6 |
| 7 | 14.1 | 16.0 | 1.94 | 7.92 | 35¾ | 65¾ | 34⅛ | 5 | 2.40 | 6.7 |
| −2 | 6.5 | 8.5 | 2.63 | 10.42 | 61 | 88¾ | 55⅛ | 6 | 2.40 | 3.9 |
| 19 | 6.8 | 6.2 | 1.36 | 4.42 | 34⅞ | 45⅝ | 28¼ | 8 | 1.00 | 2.9 |
| −43 | 3.3 | 6.7 | 0.43 | 3.50 | 37¾ | 69⅛ | 35¼ | 11 | 1.60 | 4.2 |
| 16 | 5.5 | 5.2 | 1.27 | 4.07 | 38 | 43¾ | 30¾ | 10 | 1.10 | 2.9 |
| −29 | 2.9 | 5.0 | 1.58 | 6.88 | 60 | 71⅞ | 41 | 8 | 3.20 | 5.3 |

1981, $135 million in second-quarter 1981, and a $62 million charge in fourth-quarter 1980; Union Oil—$24.4 million in second-quarter 1981; Cities Service—$290 million charge in fourth-quarter 1981.

## Petrochemical earnings plummeted in the fourth quarter

Petrochemicals are, so to speak, the chemical industry's financial accent mark. They frequently copy the rest of the industry's performance, but in italics. When the chemical industry is up, petrochemicals are *really* up. And when the industry is down, petrochemicals are *really* down.

Given this tendency, petrochemical results in the fourth quarter are no mystery. If the leading basic chemicals companies were reporting earnings declines, petrochemicals were almost guaranteed a bath. And they got one.

Petrochemical earnings slumped a combined 69% in the fourth quarter from a year before at five leading U.S. oil companies supplying after-tax data. For all of 1981, earnings dropped 36%. That's disheartening for several reasons. Petrochemical earnings had shown their first signs of life in a year this past summer, nearly holding their own from the previous third quarter. That was major improvement after declines of 18% in the second quarter and 55% in the first quarter.

If the statistics weren't bad enough, petrochemicals' profits pinch hurts from a strategic (long-run) point of view. Oil companies' petrochemical operations are the largest part of chemical production outside basic chemical companies. Trouble here means that a large part of chemical investment isn't paying off. Thinking ran a few years ago that by now bedrock chemicals such as these should be close to a desirable return on investment following several years of restrained new-plant spending and restored economic growth. Unfortunately, this timetable has been seriously delayed, and chemicals are ailing at some of the nation's largest companies.

To start with the biggest company of all, Exxon had a physical volume decline in chemicals of 5% in 1981 from recessionary 1980, says chairman Clifton C. Garvin Jr. Because of "soft market conditions worldwide," this drop led to chemical earnings downswings of 44% in the fourth quarter and 34% for the year. Garvin adds that the main damage came outside the U.S. "Most of the earnings decline occurred in Europe and Canada, where profit margins were affected significantly by excess capacity and rising costs."

Mobil, with chemical earnings drops of 39% in the fourth quarter and 23% for the year, echoes Exxon's remarks about poor performance in Europe and adds that earnings also were lower for petrochemicals in the U.S.

Even worse off, Gulf Oil says that its chemicals had an operating (pretax) earnings loss of $34 million in 1981 after a profit of $126 million in 1980. "Losses were even greater in the U.S., where sales volumes and prices eroded in the face of industry overcapacity and deterioration in such major markets as autos and housing."

In much the same shape, Atlantic Richfield reports a pretax loss of $11 million on its chemicals in the fourth quarter and earnings of just $18 million for the year, down from $133 million in 1980. Elaborating on specific chemical production poundage, Arco says that olefins were down 50% year-to-year in the fourth quarter, aromatics down 11%, and polymers down 29%.

| | AFTER-TAX EARNINGS | | | | | |
|---|---|---|---|---|---|---|
| | Fourth quarter | | | Full year | | |
| $ Millions | 1981 | 1980 | % change | 1981 | 1980 | % change |
| Exxon | $44.0 | $ 75.0 | −44% | $266.0 | $402.0 | −34% |
| Mobil | 22.0 | 36.0 | −39 | 92.0 | 119.0 | −23 |
| Shell Oil | −11.0 | 18.0 | def | 24.0 | 128.0 | −81 |
| Standard Oil (Ind.) | −9.4 | 28.6 | def | 101.0 | 144.4 | −30 |
| Texaco | 13.0 | 29.0 | −55 | 75.0 | 77.0 | −2 |
| TOTAL | $58.6 | $186.6 | −69% | $558.0 | $870.4 | −36% |

def = deficit

## Earnings also weaken at many diversified chemical producers

| | % chemical sales | FOURTH-QUARTER 1981 Sales ($ millions) | Earnings ($ millions) | Change from 1980 Sales | Earnings | Profit margin[a] 1981 | 1980 | FULL-YEAR 1981 Sales ($ millions) | Earnings ($ millions) | Change from 1980 Sales |
|---|---|---|---|---|---|---|---|---|---|---|
| General Electric | 4% | $7560.0 | $452.0 | 9% | 11% | 6.0% | 5.9% | $27,240.0 | $1652.0 | 9% |
| U.S. Steel[b,c] | 12 | 3283.3 | 101.8 | −4 | −46 | 3.1 | 5.6 | 13,940.5 | 672.6 | 12 |
| Procter & Gamble[b] | 4 | 2900.0 | 191.0 | 5 | 21 | 6.6 | 5.6 | 11,600.0 | 730.0 | 4 |
| Dart & Kraft[b] | 11 | 2635.3 | 77.4 | 8 | −20 | 2.9 | 4.0 | 10,211.0 | 413.3 | 8 |
| 3M | 15 | 1577.0 | 161.0 | 5 | −4 | 10.2 | 11.1 | 6,508.0 | 673.3 | 7 |
| Georgia-Pacific | 13 | 1222.0 | 22.0 | −7 | −66 | 1.8 | 4.9 | 5,414.0 | 160.0 | 8 |
| Aluminum Co. of America[b] | 10 | 1089.5 | 32.3 | −16 | −69 | 3.0 | 8.0 | 4,977.5 | 286.7 | −3 |
| Borden | 34 | 1063.4 | 42.4 | −4 | 25 | 4.0 | 3.1 | 4,415.2 | 159.9 | −4 |
| FMC | 35 | 875.5 | 53.2 | 5 | 39 | 6.1 | 4.6 | 3,366.7 | 176.5 | 5 |
| Martin Marietta | 10 | 860.5 | 38.6 | 21 | −11 | 4.5 | 6.1 | 3,294.1 | 200.1 | 26 |
| Esmark[b] | 13 | 849.9 | 27.4 | 12 | 72 | 3.2 | 2.1 | 3,132.3 | 99.6 | 15 |
| Pfizer[b] | 14 | 822.5 | 75.9 | 0 | 18 | 9.2 | 7.8 | 3,249.7 | 273.7 | 7 |
| Northwest Industries[b,c] | 6 | 821.7 | 79.8 | 16 | 58 | 9.7 | 7.1 | 3,121.6 | 252.9 | 29 |
| Merck | 16 | 760.4 | 92.1 | 7 | −3 | 12.1 | 13.3 | 2,929.5 | 398.3 | 7 |
| Kaiser Aluminum | 13 | 717.5 | −16.0 | −14 | def | def | 5.2 | 3,225.5 | 132.9 | −8 |
| Borg-Warner | 24 | 691.1 | 52.6 | −2 | 40 | 7.6 | 5.4 | 2,761.2 | 172.1 | 3 |
| NL Industries | 19 | 671.6 | 92.0 | 31 | 106 | 13.7 | 8.7 | 2,463.8 | 310.2 | 36 |
| General Tire & Rubber[b] | 19 | 547.0 | 21.2 | 1 | −22 | 3.9 | 5.0 | 2,175.2 | 70.3 | 17 |
| National Distillers[b] | 36 | 521.0 | 36.9 | −5 | −4 | 7.1 | 7.0 | 2,032.0 | 136.7 | −1 |
| Koppers[c] | 30 | 513.4 | 14.1 | 1 | 25 | 2.7 | 2.2 | 2,018.6 | 51.6 | 5 |
| Emhart | 16 | 469.0 | 26.0 | −3 | 160 | 5.5 | 2.1 | 1,747.0 | 75.0 | −3 |
| SCM[b] | 13 | 466.0 | 11.0 | −2 | −5 | 2.4 | 2.4 | 1,916.2 | 51.2 | 1 |
| Cabot[b] | 31 | 399.7 | 25.6 | 3 | −8 | 6.4 | 7.2 | 1,635.7 | 107.8 | 12 |
| Big Three Industries | 30 | 214.5 | 29.8 | 18 | 25 | 13.9 | 13.2 | 823.2 | 108.9 | 25 |
| Vulcan Materials | 37 | 197.0 | 18.0 | −1 | −12 | 9.1 | 10.3 | 783.3 | 78.2 | 4 |

a After-tax earnings as percentage of sales. b Excludes major nonrecurring earnings: U.S. Steel—$349 million in third-quarter 1981, $55.5 in first-quarter 1981, and $37.6 million in third-quarter 1980; Procter & Gamble—$75 million charge in third-quarter (calendar) 1980; Dart & Kraft—$85.8 million charge in fourth-quarter 1981; Aluminum Co. of America—$9.5 million in third-quarter 1981 and $27.3 million in 1980; Esmark—$388 million in fourth-quarter 1980; Pfizer—$52.4 million charge in first nine months 1981; Northwest Industries—$141

C&EN's survey, the fourth quarter showed much the same choppy pattern of financial results as in the third quarter. Although all were flying high in overall performance just a year ago, nine of these companies ended the fourth quarter with earnings up, seven with earnings down, and one unchanged from fourth-quarter 1980. Sales fell for three and rose for 14. Profit margins slipped for nine and rose for eight.

For all of 1981, the petroleum companies had quite a comedown from 1980. Although all had higher sales, 10 of the 17 had lower earnings, and 14 had lower profit margins. The three companies that still pushed up profit margins were Shell Oil, Union Oil, and Kerr-McGee.

Chemicals were a strong undertow for oil and gas firms' earnings, especially in the fourth quarter but also for the full year.

Among 25 nonpetroleum companies in C&EN's survey of diversified chemical producers, the fourth quarter was distinctly worse than the third quarter. Year-to-year data show earnings down for 13 and up for 12 in the fourth quarter and sales actually down for 10 and up for 15. Profit margins in these companies came out much like earnings in the fourth quarter—up for 13, down for 11, and unchanged for one. Perhaps it is noteworthy that 13 companies managed to increase profit margins in these circumstances. A rundown of these firms shows several in the wake of major reorganizations designed in large measure to beef up future profitability—Borden, Esmark, FMC, and NL Industries. Others are in the middle of a resurgence in corporate performance—Procter & Gamble, Pfizer, Northwest Industries, Borg-Warner, and Emhart.

Chemicals gave these companies plenty of problems in the fourth quarter, although there were exceptions. One company directly in the path of the economic storm was Georgia-Pacific, primarily a forest products firm. Chairman Robert E. Flowerree is in a better position to say than most when he comments, "High interest rates continued to depress residential construction, and the general economic recession had increasing impact on our paper and chemical businesses." However, he adds that the company's construction-related chemicals could come back quickly when conditions improve.

Another wrenching comment on the state of such durables markets comes from U.S. Steel. Chairman David M. Roderick notes, "Fourth-quarter 1981 steel product shipments were the lowest nonstrike quarter since the second quarter of 1946, and steel's operating rate was approximately 50% of capability, yet steel was profitable. These conditions are now expected to continue for the first half of 1982." This is bad news for industrial gases, lime, magnesium, and other chemicals going into steel as well as a poor indication for major steel markets, especially autos.

It is hard for large-volume chemicals to continue unscathed when basic industrial products such as steel and wood are in depressed conditions. For example, National Distillers' U.S.I. petrochemical division had a profit drop in the fourth quarter because of "weak market conditions and inade-

| FULL-YEAR 1981 | | | STOCK MARKET DATA | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Change from 1980 | Profit margin[a] | | Earnings per share | | Stock price | | | Price-earnings ratio | Annual indicated | Dividend yield, % |
| | | | | Recent | | Recent 12 months | | | dividend | of price |
| Earnings | 1981 | 1980 | Jan. 29 | 12 months | Jan. 29 | High | Low | Jan. 29 | | |
| 9% | 6.1% | 6.1% | $1.99 | $7.26 | $62½ | $ 69⅞ | $51⅛ | 9 | $3.20 | 5.1% |
| 44 | 4.8 | 3.7 | 1.09 | 7.16 | 26⅛ | 35¼ | 23⅝ | 4 | 2.00 | 7.7 |
| 10 | 6.3 | 5.9 | 2.31 | 8.84 | 85¼ | 85¼ | 65⅛ | 10 | 4.20 | 4.9 |
| 8 | 4.1 | 4.1 | 1.40 | 7.56 | 52 | 54¾ | 42½ | 7 | 3.40 | 6.5 |
| 1 | 10.4 | 11.0 | 1.37 | 5.74 | 56⅛ | 65 | 48 | 10 | 3.00 | 5.3 |
| −34 | 3.0 | 4.8 | 0.21 | 1.49 | 18¾ | 32⅜ | 17¼ | 13 | 1.20 | 6.4 |
| −35 | 5.8 | 8.6 | 0.42 | 3.80 | 23 | 37½ | 22½ | 6 | 1.80 | 7.8 |
| 8 | 3.6 | 3.2 | 1.38 | 5.20 | 29⅞ | 30 | 25 | 6 | 2.05 | 6.9 |
| 25 | 5.2 | 4.4 | 1.46 | 4.88 | 25⅛ | 35¾ | 23⅛ | 5 | 1.60 | 6.4 |
| 6 | 6.1 | 7.2 | 1.08 | 5.39 | 31⅜ | 51⅛ | 28⅜ | 6 | 1.92 | 6.1 |
| 83 | 3.2 | 2.0 | 2.10 | 7.49 | 48⅛ | 55½ | 24¼ | 6 | 1.84 | 3.8 |
| 8 | 8.4 | 8.4 | 1.00 | 3.63 | 55½ | 56½ | 40 | 15 | 1.84 | 3.3 |
| 82 | 8.1 | 5.7 | 2.91 | 8.52 | 73⅛ | 76⅜ | 35¾ | 9 | 2.63 | 3.7 |
| −4 | 13.6 | 15.2 | 1.24 | 5.36 | 84⅝ | 103 | 76¼ | 16 | 2.80 | 3.3 |
| −56 | 4.1 | 7.1 | −0.36 | 3.00 | 14¼ | 27½ | 14 | 5 | 1.40 | 9.8 |
| 36 | 6.2 | 4.7 | 1.22 | 4.00 | 27 | 28¾ | 18⅝ | 7 | 1.40 | 5.2 |
| 96 | 12.6 | 8.7 | 1.37 | 4.61 | 34¾ | 48⅝ | 29½ | 8 | 1.00 | 2.9 |
| 149 | 3.2 | 1.5 | 0.87 | 2.86 | 20 | 29½ | 18⅝ | 7 | 1.50 | 7.5 |
| −3 | 6.7 | 6.9 | 1.08 | 3.97 | 23⅜ | 29¾ | 22 | 6 | 2.20 | 9.4 |
| −4 | 2.6 | 2.8 | 0.43 | 1.58 | 15½ | 27¼ | 15¼ | 10 | 1.40 | 9.0 |
| 15 | 4.3 | 3.6 | 2.02 | 6.06 | 33¾ | 37½ | 26⅛ | 6 | 2.40 | 7.1 |
| −12 | 2.7 | 3.1 | 1.10 | 4.99 | 21½ | 31⅝ | 20⅛ | 4 | 2.00 | 9.3 |
| 11 | 6.6 | 6.6 | 0.81 | 3.42 | 22⅛ | 35½ | 19⅞ | 6 | 0.92 | 4.2 |
| 26 | 13.2 | 13.1 | 0.70 | 2.57 | 25¼ | 38 | 22½ | 10 | 0.60 | 2.4 |
| 12 | 10.0 | 9.3 | 1.55 | 6.76 | 48½ | 56 | 40⅛ | 7 | 2.20 | 4.5 |

million in fourth-quarter 1981; General Tire—$4.4 million charge in first-quarter 1981; National Distillers—$30 million charge in 1980; SCM—$2.4 million charge in fourth quarter (calendar) 1981, $3.2 million charge in second-quarter (calendar) 1981, and $0.7 million charge in first-half (calendar) 1980; Cabot—$46.4 million in third-quarter (calendar) 1980. c Includes nonrecurring earnings.

quate pricing for polyethylene and vinyl acetate, two of its principal products."

Two other severe current problems for diversified chemical producers—the fertilizer market and natural gas prices—both had an impact on Borden. The company's chemical division operating (pretax) income declined 29% to $73.8 million because of a loss of $30 million in income from discontinued operations, largely phosphates and fertilizer, and about $60 million in increased natural gas costs. Borden currently is suing Texaco for $200 million for canceling a low-cost gas contract for about half its gas needs in chemicals.

If these production conditions weren't enough, a purely financial wrinkle has eaten away earnings at some heavily 'multinational companies—the stronger U.S. dollar. The foreign exchange factor handed Merck year-to-year earnings drops of 3% for the fourth quarter and 4% for all of 1981. Without this influence, earnings would have been up 16% in the quarter and 14% for the year. Merck's sales gain was reduced from 20% to 7% for the quarter and from 17% to 7% for the year. Similarly, at Pfizer, currency fluctuations slashed net income growth from 52% to 18% for the fourth quarter and from 43% to 8% for the year. Sales growth was whacked by about 8 percentage points in the quarter and 5 points for the year.

Besides these direct influences, currency shifts have other quieter effects. 3M chairman Lewis W. Lehr says that additional adverse effects that cannot be quantified with precision include higher costs in local currencies when overseas subsidiaries buy goods from a U.S. parent company.

Despite this backdrop of financial and market gloom, certain chemical operations still managed performance gains in the fourth quarter or the full year. For example, NL Industries more than tripled its operating (pretax) profit in its chemical operations, dominated by titanium dioxide, in the fourth quarter from a year ago. And NL notes that its 50%-owned titanium metals venture had a 67% earnings gain because of strong demand and pricing in titanium mill products and increased demand for oil field-related steel products.

Elsewhere, Kaiser Aluminum & Chemical reports that both its agricultural and industrial chemicals operations had profit pickups for full-year 1981. FMC says that sales and earnings increased strongly in the fourth quarter in pesticides from early ordering and food additives from market penetration overseas. And as before, Vulcan Materials had another strong quarter in its chemicals (influenced by shortage-plagued caustic soda) with both sales and pretax earnings gains of 8% from fourth-quarter 1980. For all of 1981, Vulcan's chemicals had a sales gain of 19% and earnings increase of 42% from 1980.

Nevertheless, Vulcan Materials president W. H. Blount calls the fourth quarter a slowdown and forecasts that it will carry over into the first quarter of 1982. Blount predicts lower first-quarter earnings for Vulcan and flat earnings for the year even with a significant economic upturn. □

# Fewer recent Ph.D.s on science faculties

**NSF study shows proportion of young faculty members in Ph.D.-granting departments dropped to 21% in 1980, continuing decade-old decline**

The proportion of recent doctorates on the full-time faculties of science and engineering departments in Ph.D.-granting institutions has continued to decline over more than a decade. And that proportion is well below what department heads consider optimal.

A survey conducted by the National Science Foundation in the spring of 1980, and just published, documents that drop. Overall, the proportion of recent doctorates—those holding their degrees for seven years or less—had dropped to 21% in 1980.

The 1980 survey is the third in a series started by NSF in 1968. Besides monitoring the proportions of young faculty members in Ph.D.-granting departments, the 1968 survey also compared tenure status and research activities of recent and senior doctorates. A second survey followed in 1974 and included new information on faculty tenure status.

In scope, the 1980 survey was expanded to include new questions on faculty appointments and departures. Also, for the first time, the new edition includes data on age, sex, and race/ethnic makeup of faculties.

The 1980 survey included all of the 156 institutions that had awarded at least one science/engineering degree in 1975–76 and received at least $1.4 million in federal funds for R&D in 1977. The final weighted results represent a total of 39,760 full-time faculty members in 19 science/engineering fields.

**Recent doctorates below percentage desirable**

| Field | Recent doctorates, % of total doctorate faculty | Recent doctorates desired by department heads, %[a] |
|---|---|---|
| Engineering | 22% | 30% |
| Chemical | 24 | 29 |
| Civil | 25 | 29 |
| Electrical | 19 | 29 |
| Mechanical | 22 | 30 |
| Physical sciences | 15 | 25 |
| Chemistry | 16 | 27 |
| Geology | 20 | 28 |
| Physics | 11 | 22 |
| Biological sciences | 20 | 27 |
| Biochemistry | 14 | 25 |
| Mathematical/ computer sciences | 26 | 30 |
| Social sciences | 30 | 33 |
| Psychology | 27 | 34 |
| All selected fields | 22 | 30 |

[a] Median value of responses. Note: Data are from spring 1980. Source: National Science Foundation

**Less than a third of faculty members in engineering, physical sciences are under 40 years old**

| Field | All faculty | Age, % | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Under 30 | 30–39 | 40–49 | 50–54 | 55–59 | 60–64 | 65–69 | Over 70 |
| Engineering | 7236 | 6% | 28% | 34% | 13% | 12% | 6% | 2% | 0 |
| Chemical | 1039 | 10 | 25 | 31 | 14 | 10 | 8 | 1 | 0 |
| Civil | 1886 | 4 | 29 | 34 | 12 | 12 | 6 | 2 | 0 |
| Electrical | 2313 | 6 | 28 | 35 | 14 | 11 | 6 | 2 | 0 |
| Mechanical | 1998 | 6 | 23 | 36 | 12 | 14 | 6 | 2 | 0 |
| Physical sciences | 8354 | 3 | 27 | 36 | 14 | 11 | 7 | 2 | 0 |
| Chemistry | 3380 | 4 | 30 | 34 | 12 | 10 | 7 | 3 | 0 |
| Geology | 1394 | 5 | 28 | 34 | 14 | 9 | 7 | 2 | 0 |
| Physics | 3580 | 2 | 26 | 38 | 15 | 12 | 6 | 2 | 0 |

Note: Data are from spring 1980. Source: National Science Foundation

The drop of recent doctorates to 21% of full-time faculties (including nondoctorates) in 1980 represented a sharp decrease from the 28% of 1974 and was considerably below the 39% of 1968. It also was well below the consensus of department heads that recent doctorates should make up 30% of all doctoral faculties.

Chemical engineering was the only discipline to buck the trend. Between 1974 and 1980, chemical engineering was the only field to show an increase, with a small gain to 23%. The fraction fell in 14 fields, the largest drop being in mathematics, where the share went from 35% to 22%.

Chemical engineering stood out in another feature as well. The fraction of full-time faculty with tenure rose in 12 of the 15 fields surveyed in both 1974 and 1980, with an average gain of about 5%. Only chemical engineering, at 73%, had a significantly lower tenure proportion in 1980 than in 1974. The greatest concentration of tenured faculty in 1980 was in physics, at 83%, and the lowest was in computer science, at 59%. In chemistry, 79% were tenured.

Among other findings:

- About 5% of full-time faculty members in 1978–79 changed employers or left the active labor force before the beginning of the next academic year. Voluntary resignations to accept other academic positions accounted for a third of the departures. Switches to nonacademic employment accounted for a fifth of the departures.
- Women had a larger level of representation among recent doctorates, 14%, than among senior doctorates, where they were 5%.
- About one in 12 faculty members belonged to race/ethnic minority groups, with a higher level of representation among recent doctorates. About two thirds of minority faculty were Asian or Pacific Islanders. The remaining minority faculty members were split about equally between blacks and Hispanics.

Copies of the report, "Young and Senior Science and Engineering Faculty, 1980" (NSF 81-319), are available free from the Division of Science Resources Studies, National Science Foundation, Washington, D.C. 20550. □

# NOTE

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